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Minimization of Hazardous Waste
Appendices

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Appendix A

OPTIONS

OPTIONS EVALUATION

Introduction

Appendix A provides a detailed evaluation of the options summarized in Chapter Three. The purpose of this appendix is to present a more complete analysis of the impacts of each option, as well as to explore the circumstances and conditions under which the option might be useful for meeting the waste minimization objectives. The evaluation criteria remain identical to those found in Chapter Three. They cover the specific characteristics of each option (i.e., technical effectiveness, impacts on industry, and implementation issues). Two additional sections provide (1) a general summary of the option (e.g., description, how it will work, and the purpose for which it would be used) and (2) recommendations for adoption as part of EPA's overall waste minimization program.

The nine options have been grouped into four categories. Three of the categories selected were mandated by Congress. These include performance standards, legislative changes to RCRA, and management practices. A fourth option category was added to cover voluntary activities industry might take to reduce waste generation. Table A–1 lists both the categories and the options.

Table A-1
List of Categories and Options

Option Category	Options
1. Performance Standards	1. Performance Standards Limiting the Volume or Toxicity of Wastes 2. Prohibit, Restrict the Generation of Specific Wastes 3. Phasedown Permits
2. Legislative Changes to HSWA	1. Modifications to Requirements for Certification of Waste Minimization
3. Management Practices	1. Ban the Landfilling, Treatment, or Incineration of Potentially Recyclable Wastes 2. Segregation of Wastes 3. Mandatory Waste Audits
4. Other Options	1. Technical Assistance Programs 2. Procurement Practices

An important issue in evaluating options is the time required for implementation. Figure A-1 displays a time line that divides each option into three different implementation stages (Congressional Action, EPA Program Milestone, and Activity of Industry). These are only preliminary estimates, and reflect EPA's best estimate of the shortest realistic implementation schedules.

General Summary

The summary section describes the option. It explains what the option would look like and how it would work. The summary also covers the purpose of the option and, where possible, describes any previous experience that EPA or State agencies may have had with the option.

Criteria for Evaluation

Waste minimization options must be evaluated not only in terms of their effectiveness in minimizing waste but also in terms of their implementation requirements. The evaluation should consider the following:

- What the private sector costs and other impacts would be on industry, as industry attempts to accommodate the many new requirements of HSWA ;
- What the internal impacts would be on EPA for each option, in terms of new research requirements, additional regulatory development burdens, and implementation and enforcement burdens; and
- What burdens would be put on States.

The criteria used to evaluate the options have therefore been put under three general headings:

- **Technical effectiveness:** How well does the option meet the goals of waste minimization?
- **Impacts on industry:** What will be the costs and other burdens of compliance with each option?
- **Implementation issues:** How will this option be implemented, and what will be the burdens on EPA and State resources?

Each of these areas is discussed separately below. As is evident from the detailed discussions contained in this appendix, the information necessary to properly answer many of these questions is often unavailable.

Technical effectiveness

The first consideration in evaluating any option is the degree to which it achieves the objectives set by Congress for minimizing the volume, or quantity and toxicity of wastes that are generated or that would otherwise be sent to land disposal (i.e., not recycled).

Volume reduction: Volume reduction is a key concern for any waste minimization option and will be particularly important in the short term, especially for those firms that must rely on offsite commercial treatment facilities. While the overall goal of waste minimization is to produce significant aggregate reductions in the total volume of hazardous waste produced each year, it may often be important in the short term to direct minimization efforts to those industries or waste streams for which treatment capacity is in shortest supply. In assessing the effectiveness of a particular option in terms of potential for reducing waste volume, questions include the following:

- What proportion of total national waste volume could it reduce?
- What proportion of the waste from the affected industries or waste streams might be reduced?

Toxicity reduction: The effectiveness of an option in achieving toxicity reduction may be harder to estimate than its effectiveness in reducing waste volume, but the questions involved are similar to those asked in regard to volume reduction:

- To what degree would the option tend to reduce the toxicity of a particular waste stream?
- Would toxicity reduction interfere with volume reduction of the option?

Other technical effectiveness issues: There may be additional criteria under this heading that are important to some options and not to others. This section will allow a more detailed discussion of the option and will focus on issues such as the following.

- **Side effects and intermedia transfers:** Important technical considerations in the evaluation of any option are the relationships between volume reduction and toxicity reduction and the possibility of unwanted transfers of pollution from one location or media to another. As pointed out in Chapter Two, for instance, volume reduction may produce more concentrated, and therefore possibly more toxic, wastes. Conversely, toxicity reduction may involve dilution of wastes, increasing their volume. Certain options may appear to effectively minimize waste, but in fact may only be transferring pollution to the air or water. Questions about such concerns include:

  - Will this option tend to produce undesirable side effects in terms of the volume or toxicity of hazardous waste reduced?
  - Will it produce adverse effects in environmental media other than hazardous waste?

- **Transaction costs:** Some waste minimization options, such as those of waste exchanges, merely facilitate access to information, i.e., they reduce the transaction costs associated with improving the management of hazardous wastes. Evaluating the technical effectiveness is, thus, quite subjective. Pertinent questions include:
  - What waste minimization transactions are affected by this option, and what specific problems is it aimed at correcting or ameliorating?
  - How effective will it be in its stated objective?

- **Measuring results:** A key factor in the technical effectiveness of any option is the degree to which its success can be predicted in advance or measured after implementation. Standards of performance, for instance, might have fairly easily predictable and specific effects on the composition and volume of wastes produced. On the other hand, it may be extremely difficult to estimate the effects produced by various types of incentive programs (such as loans, grants, or technology transfer), or options aimed at reducing transaction costs (information hotlines, waste brokers). It is not necessarily critical to be able to measure the effectiveness of an option, but it may be an important factor to consider, especially if the costs of the option are high. Questions include:
  - Is it possible to measure the effectiveness of the option?
  - If it is measurable, what are the relevant variables and what methods would be employed to measure it?

Impacts on industry

There are a variety of potential burdens that a particular waste minimization option might put on industry, especially since several of them could intrude significantly further into the details of production processes than traditional environmental programs have done. Compliance costs are usually the first concern. Other factors include equity considerations, confidentiality issues, and incentives for noncompliance.

Economic impacts: The costs of complying with a particular waste minimization option can be negative as well as positive, since waste reduction often *saves* rather than costs money. Cost questions that might be asked are the following:

- What are the capital costs associated with the option? (These may be incurred in regard to major process modifications.)
- What are its operation and maintenance costs? (These can include changes in feedstock requirements, energy use, transportation expenses, and so forth.)
- What is the reporting burden? (The costs of reporting to EPA or the State may be considerable for some options.)

Equity to industry: Because some industries, and some firms within industries, have already voluntarily begun to minimize their wastes, equity among firms can be an important consideration in determining the desirability or feasibility of a particular option. Some options may, in effect, penalize industries that have already reduced their wastes. Others may unnecessarily interfere with the current competitive structure of markets. Pertinent questions include the following:

- Do costs of compliance with this option vary significantly across firms or industries with respect to size, category, location, or some other factor?
- Does the option tend to distort markets for products, or to affect the current competitive relationships among firms or industries?
- Does the option risk violating the legitimate confidentiality of proprietary processes?

Incentives for noncompliance: Some waste minimization options could create strong incentives for noncompliance of one type or another, ranging from nonparticipation or nonreporting to deliberate violation of regulatory requirements (falsification of records, illegal dumping, etc.). Questions include:

- Does this option encourage noncompliance?
- Are enforcement tools adequate to compensate for noncompliance incentives?

Implementation issues

A wide variety of issues are of concern here, including all aspects of developing, implementing, and enforcing the option. Also important are the effects of the option on State programs, its effects on other environmental programs, its flexibility in responding to changing circumstances, its acceptability to the public, and its effects on changes in industrial technology.

Legislative authority: It is important to determine what changes will be necessary, if any, in the legislative authority in order to implement each option. The types of authority that the Agency will need depend on the option itself. In some cases, the type of additional authority could be provided by a simple ruling change (e.g., Waste Audits), whereas in others it may require extensive Congressional legislation. The types of questions that need to be answered are:

- What are the types of legislative changes that will be necessary in order to implement the option?
- Is additional legislative change necessary or can modifications be made to existing authority?
- Would a simple ruling change instead of additional legislative authority be a more appropriate method to extend the Agency's ability to implement the option?

Time required for implementation: Timing is an important variable in the evaluation of the options. For some options implementation is contingent on the outcome of other options or regulatory policies. It may be that an option will not take long to implement, but that implementation cannot occur until after the other options or policies take effect. Questions that need to be addressed are:

- What is the reasonable length of time it would take to develop the option?
- Are there delays or contingencies that might otherwise hold up the implementation of the option (e.g., land disposal restrictions)?
- How long after implementation would the option be expected to influence waste minimization?

Appropriate target industries: Not all the options are appropriate for every industry or for every waste stream. It may be necessary to identify those industries and waste streams that best meet the goals of waste minimization. Performance Standards, for example, might be a satisfactory means to minimize waste, but the type of standard would vary between the designated industries and types of waste streams. The important questions are:

- What are the most suitable industries for the option?
- What waste streams within a targeted industry are best adapted to the option?
- Will targeting industries interfere with implementation of other options?

Costs of development and implementation: These include all direct costs to the Agency for conducting research, gathering and analyzing data, writing regulations, writing permits and enforcing regulations, or any other expenses necessary under the option. If grants or awards were selected, for example, costs would include the amount of the grants or awards. Questions include:

- What would the intramural staff requirements be, at Headquarters and in the Regional Offices?
- What would extramural costs be (data gathering/data automation, research, etc.)?
- Are there any special enforcement considerations (e.g., new categories of regulated parties, history of poor compliance in regulated sector)?

Other Considerations

This final category covers criteria that may not be germane to all of the options. It is a catch all section in which it is possible to evaluate options that have unique aspects. The additional criteria include: flexibility in implementation, impacts on States, public perception, effects on other environmental programs, and effects on innovative technology.

- **Flexibility in implementation:** Flexibility may be an important issue, particularly since the context in which waste minimization is being enacted is still fluid. Options that have strict administrative requirements (such as standards of performance issued as conventional regulations) are likely to be considerably less flexible than others (e.g., performance standards enacted as phasedown permits). Questions include the following:

— To what degree can enactment of the option be negotiated with involved parties?

— Are formal administrative variance and other procedures required to modify conditions?

- **Impacts on States:** States are already an integral part of the hazardous waste management system. Their involvement in waste minimization will likewise be highly important. Questions include the following:

  — Does the option interfere with or duplicate waste minimization or hazardous waste management policies already established by the States?

  — What costs and staff burdens would the options put on the States, and how would these expenses be defrayed?

  — Is voluntary State involvement required in order for the option to work?

  — Must State involvement be uniform across the country for the option to work?

- **Public perception:** Because the whole subject of hazardous waste management is of such concern to the general public, waste minimization options must be compatible with public opinion. Some of the options under consideration may be more difficult for the public to accept than others: for instance, the public has always been skeptical of environmental programs that appear to operate on a "pay-to-pollute" basis. Therefore, although options like phasedown permits are considered to be an economically efficient way to reduce waste generation, the public may not endorse a program where companies buy permits that allow them to generate hazardous materials. On the positive side, it may also be important to consider whether a given option reduces public anxiety about hazardous waste. Many companies have already embarked on voluntary waste minimization programs partly to improve their public environmental image. The key questions are summarized below.

  — Is this option compatible with public opinion?

  - Does it allow industry to take legitimate credit for voluntary actions taken to reduce hazardous wastes?

- **Effects on other environmental programs:** Some waste minimization options may require extensive internal cooperation among EPA programs. An example would be the use of the effluent guidelines program to restrict hazardous waste generation. If such cross program relationships are important, they should be identified in advance. The types of questions that need to be answered are listed below.

  - Does this option shift any wastes or risks out of the jurisdiction of the hazardous wastes system and into that of another program?
  - If so, have such shifts been made deliberately, and are they in the overall best interests of protecting human health and the environment?
  - If not, can they be mitigated or corrected?

- **Effects on innovative technology:** Some options may tend to stimulate technological innovations in reducing the generation of hazardous waste, others may tend to stifle innovation and lock in existing technology. Major questions would be:

  - Would this option have a positive or a negative effect on technological innovation?
  - If so, would such effects have been noted in the development of the option?

Recommendations

This section will discuss the circumstances and conditions under which the option would be useful for waste minimization. It may not be possible to draw definitive recommendations, since many of the ramifications of the options are still unclear. However, to the extent possible, the recommendations will stress the desirability and feasibility of implementing any changes in waste minimization policy mandated in the Hazardous Solid Waste Amendments (HSWA) of 1984.

Performance Standards Limiting the Volume or Toxicity of Wastes from Generators

1.0 General Summary

Under this option, performance standards setting limits on the volume or toxicity of waste generation would be enacted as formal and enforceable regulations, similar in concept and operation to those established elsewhere for the control of air and water pollution (for example, under the Clean Air Act and the Clean Water Act). Performance standards of this type could be applied either to an individual industry, to a particular waste generating operation within an industry, or to common processes among several different industries. A major difference in this case, however, is that while performance standards for air and water pollution are usually based on pollution control procedures *following* production, performance standards for waste minimization would commonly be based on changes within manufacturing processes themselves.[1] Performance standards based on assumptions of process change or process control would require substantially more information on industrial processes than is generally required for air and water pollution "end-of-pipe" controls. They also have potentially greater implications for both product quality and the economics of manufacturing.

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[1] A reduction in the generation of metal hydroxide sludges or spent etchants might be required of printed circuit board manufacturers, for example, based on assumptions as to the additional reductions that could be made if a plant switched from the additive to the subtractive process of etching. A performance standard could be stated in terms of volumes of sludge or spent etchant per unit of production.

Another potential example would be a performance standard requiring reductions in the generation of ethyl chloride, vinylidene chloride, or 1-1 dichloroethane in the production of vinyl chloride monomer. Such a standard would be based on the assumption that the oxychlorination step in the production of ethylene dichloride would be replaced by a direct HCl oxidation step. (This would probably only be economically feasible—if at all—for new, large-scale operations.)

On the other hand, however, some standards could be based on the use of good operating practices preceding a production process. One example of such a practice is segregating wastes into distinct, usable components, rather than mixing all the wastes in a way which only allows the material to be disposed of. A printing firm, for example, segregated the toluene used to clean its presses according to the type and color of the ink cleaned and was then able to reuse the toluene to thin future batches of the same ink, rather than having to dispose of all the toluene. A standard requiring such an operating practice might either specify the volume of toluene that could be disposed of per cleaning or simply require the segregation of the wastes.

In some cases, it might be feasible to base a performance standard on the assumption that a waste would be reused or reclaimed within the plant itself. (Alternatively, such use could be mandatory, although such mandatory practices decrease the plant`s flexibility in meeting the performance requirements.) Such a requirement or assumption, however, could not reasonably be made where the waste could not be recycled within the plant itself, since market economics and purity specifications would alter demand for the material over time. In order to encourage recycling rather than disposal of wastes, without creating rigid recycling requirements or assumptions that might prove to be unrealistic, it might be desirable to develop a system of credits for recycled wastes. Essentially, every volume unit of a waste recycled would be credited against (or "subtracted" from) the volume generated.[2]

Performance standards could also impose limits on the toxicity of a waste stream, specifying an allowable toxicity limit per unit volume of the waste stream, or placing ceilings on toxicity per unit volume of production. To accomplish this, some type of weighted toxicity index would probably have to be developed to characterize a stream's toxicity and to set acceptable levels for changes in toxicity once the performance standard was implemented (as is done using copper toxicity as the basis for the cost-effectiveness analyses for the effluent guidelines).[3]

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[2] The operation of a credit system would depend on the specifications of the performance standard. The relevant elements for a performance standard would include the amount of a waste stream, or toxic constituent, generated per unit of production or throughput (the rate of generation), the production capacity per hour, and the hours of production operation.

If only the rate of generation were specified in the standard, the total volume of a waste stream that a facility would be permitted to generate could be based either on (a) the actual historical capacity utilized and hours of operation at the facility or (b) the assumption that the facility may operate at full capacity 24 hours per day. Whichever basis is used, the multiple of the three factors would give the total volume of the particular waste that a plant would be permitted to generate.

Under a credit system, a plant that exceeded its total allowable limit on a particular waste stream could come into compliance with the performance standard by recycling some proportion of the waste and crediting the volume recycled against the excess volume generated. A credit system could be expanded in scope beyond such straightforward credit-for-recycling for a single waste stream to create substantial flexibility within a performance standard system.

Performance standards can be selective. As applied to a particular industry, it would be possible to select the most appropriate generators within the industry rather than to apply standards to the industry as a whole. For instance, a regulation could specify that only facilities generating waste above a specific volume threshold must meet the standard, or that only certain processes would have to meet the standard. Similarly, it might be appropriate to write standards for wastes generated by one industrial process, yet not regulate the same type of waste if it were generated by a different type of process or by a different sector of industry. Conversely, similar wastes generated by different industries could be required to meet identical performance standards. For example, solvent wastes from the cleaning of metal parts in several industries might be regulated using the same standards of compliance (e.g., metal furniture, nonelectric machinery, electric equipment, transportation equipment).

The basic choices are as follows:

- Performance standards could be applied to new and existing sources, or they could be restricted to new sources—at least in cases where costly process change retrofits would be required of the existing sources.
- Performance standards could be developed broadly for each major industrial category, specifying limitations for regulated pollutants for each process within that category (as is done with effluent guidelines). Alternatively, they could be written for specific waste streams identified because of high volume and/or high toxicity, and developed for all sources of that waste stream (as with the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) standards)—e.g., for specific solvents or specific metal-bearing wastes.

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[3] The weighted toxicity index would have to take into account a number of factors, such as the toxicity value of a chemical compound as measured against a common standard (e.g., some fraction or multiple of the toxicity of copper), the mass fraction of the toxic constituent within the waste stream, and the total volume of the waste stream.

- Standards could be developed to generally reduce the total volume of hazardous wastes, to more narrowly focus on selectively reducing the most toxic wastes, or sequentially to attack both problems (as with the best practical control technology (BPT) and the best available technology (BAT) under the effluent guidelines program).

- In addition to, or in place of, performance standards for the actual reduction of waste generation, standards for some industrial processes could specifically incorporate requirements for recycling the waste that has been generated.

- A performance standard system could be based entirely on minimization waste stream by waste stream, of the hazardous waste generated during production, or credit could be given for any of several alternative waste minimization activities. Credits could be used to offset the generation of excess volumes of a particular waste. Alternatively, the credits generated from reductions in one waste stream could be used to offset excess generation from another waste stream, as long as the waste stream producing the credits is of equal or greater per unit toxicity than the waste stream with excess generation. Credit could also be given for waste minimization or sound waste treatment practices such as the following:

    — Recycling of hazardous wastes, whether by the generator or by another plant or manufacturer;

    — Over control (beyond that required under the applicable performance standard) of a waste stream by a generator; and

    — Onsite incineration of hazardous wastes.

- Credits could either be allotted on a pound-for-pound basis (one pound credit for each pound of creditable over control, recycling, or incineration) or on a discounted basis (e.g., credit for one pound for every two pounds of actual creditable reduction). In order to prevent the possibility of a credit system wherein the least toxic waste is purposely over controlled to provide credit for a more toxic waste, however, it may be necessary to restrict credits to the same toxicity class or to only allow the use of credit from a more toxic waste stream to a less toxic waste stream. Credit use could also be restricted to the individual generator. The system could be made still more flexible if a generator that produces more credits than is needed for its own operations could allot extra credits to other plants.

Although EPA has not had experience with performance standards for the minimization of hazardous wastes, it has had substantial experience with performance standards for the reduction of air and waste pollution. EPA has used performance standards restricting the rates of emission, concentrations, or total volume of various pollutants as the primary means for achieving pollution control under the Clean Air Act and the Clean Water Act. These standards and examples provide some guidance as to how the Agency might adapt performance standards to waste minimization.

Under the Clean Air Act (Section 111), New Source Performance Standards (NSPS) for new stationary sources of air pollution are established for each major category of pollution source for each of the criteria pollutants (e.g., sulfur dioxide, volatile organic compounds, nitrogen oxides). The NSPS are emission limitations that apply to new or modified sources of air pollution in specific industrial categories. Some of the standards apply to pieces of equipment that are not specific to any one industry, such as industrial boilers fired by fossil fuels. Other standards apply to equipment that is industry specific, such as particulate emissions from fluid catalytic cracking units in petroleum refineries. Emissions can be expressed in terms of pounds per million BTU heat input (1.2 lbs SO_2 emissions per million BTU), volume per unit of production or application (e.g., 0.2 kg of volatile organic compounds per kg of coating solids applied), or a concentration limit of the total stack gas volume being emitted (e.g., 650 ppm SO_2 for emissions from copper smelting furnaces).

Some of the NSPS are expressed in terms of a work practice and/or equipment standard rather than a performance standard. For example, petroleum dry cleaners are required to use cartridge filters for solvent filtration systems, and used cartridge filters must be drained for at least eight hours in their closed housings prior to disposal.

Existing facilities are regulated under the Clean Air Act through Reasonable Available Control Technology (RACT) performance standards, which are similar in design and function to the NSPS standards for new facilities. The basic RACT standards are developed by EPA. The States then incorporate the RACT standards (or equivalent or stricter standards) into their own regulations for facilities within the State. EPA reviews the regulations for consistency with the requirements established by the Agency. Both EPA and the State have the authority to take direct enforcement action against any facility that violates the regulation.

NSPS and RACT performance standards apply to emissions of pollutants which, though they have adverse health effects, are not currently deemed severely toxic or carcinogenic. The only performance standards intended specifically to limit emissions of highly toxic pollutants are the National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Functionally, these apply to facilities or classes of equipment in precisely the same way as the NSPS and RACT standards.

In developing such performance standards, primary consideration is usually given to the efficiencies of available control technologies (e.g., scrubbers, baghouses, incinerators) for cleaning or controlling the emissions after they exit the process units. In some cases, however, consideration may also be given to the potential for process or input changes (e.g., operating parameters and type of resins used for the stripping unit for vinyl chloride, or the substitution of water based paints for solvent based paints for paint spray coating systems).

Under the Clean Water Act, effluent limitations are established for various pollutants through sets of performance standards applied to plants in specific industrial categories. For existing sources, the largest volumes of conventional effluent pollutants (e.g., total suspended solids, nutrients) are reduced through the Best Practicable Control Technology (BPT) currently available. An additional level of controls, Best Available Technology (BAT) economically achievable, is applied with the specific purpose of reducing toxic effluents remaining after the imposition of BPT. Requirements for new sources are developed under the New Source Performance Standards (NSPS). For those sources that send their effluents to publicly–owned treatment works (POTWs) instead of directly into rivers or lakes, pretreatment standards have been developed both for existing sources (PSES) and new sources (NSPS).

Under both statutes, periodic review of the performance standards is required to take into account new technological developments that could lead to more effective control of pollutants. If it is found that technology has improved the ability to meet the performance standards, these standards can then be incorporated into the regulatory requirements.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

Although performance standards can provide one of the most direct means of requiring volume reductions in the generation of hazardous wastes, it is not possible to determine at present what the effect of such standards would be. Furthermore, current data are not sufficient to establish a useful baseline for measurement of progress. Before making a decision on the desirability of performance standards, the Agency will have to differentiate between the projected impacts of performance standards and those occurring as the result of (1) increased disposal costs caused by the land disposal restrictions and (2) concerns for future liability.

Once this information is available, performance standards would provide a basis for achieving predetermined percentages of reductions in the generation of wastes. Facilities that wished to retain operating permits would have to meet such reduction requirements, either directly or through credits from recycling or, possibly, from other waste reduction or treatment activities (see list of creditable alternatives in the discussion above).

Toxicity Reduction

As noted above, performance standards could also be used to reduce waste stream toxicity. Such standards might be analogous to BAT standards under the Clean Water Act, where copper toxicity is used as a reference point for effluent guidelines analysis. Examples of wastes that might be selected for the purpose of toxicity reduction are those produced by the organic chemicals industry, which produces some of the most toxic wastes listed by RCRA (e.g., heavy ends from distillation of vinyl chloride in vinyl chloride monomer production [K020] and distillation bottoms from the production of 1,1,1—trichloroethylene [K095][4]).

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[4] K020 and K095 are both ranked extremely high in toxicity.

Other Technical Effectiveness Issues

Impact on innovative technology: In some cases, generators might choose to simply meet required performance targets rather than look for the most efficient method of reducing wastes. A standard that defines compliance narrowly might therefore have an adverse effect on technological innovation. Such effects have been noted in the past.

For example, in order to meet RACT standards for volatile organic compounds (VOC) required under the Clean Air Act, flexographic printers needed either to use water based inks or to install incinerators. Over the long term, use of the water based inks would be the environmentally preferable alternative. But when the ink companies were unable to develop water based inks rapidly enough to ensure meeting the compliance deadline, the flexographic printers installed incinerators. Once the incinerators were installed, there was no longer any incentive to continue research on water based inks.[5]

2.2 Impacts on Industry

Economic Impacts

On the basis of current data, it is impossible to predict what a performance standard program for waste minimization would cost industry, either in terms of aggregate capital and operation and maintenance costs, or in terms of cost per ton of reduction in waste generated or recycled. Performance standards have the potential, however, for being one of the *least* economically efficient approaches to waste minimization.

The actual cost of this type of program for industry would depend on its final structure. For example, the most costly approach would probably be to mandate performance standards on an individual waste stream basis, with no credit for recycling (which could be required by a performance standard in some cases), onsite incineration, or over control of other waste streams. The higher costs and lower economic efficiency of this form of performance standard would be due to the rigidity of the performance regulations and the absence of any compensating relief for generators.

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[5] Yates and Auberle, November 1985, *Bubbling of Volatile Organic Compound Emissions*, (draft), prepared for the Regulatory Reform Staff, USEPA.

An illustration of the discrepancy in costs that can occur among performance standards can be illustrated by looking at the cost of the various control measures required under the promulgated effluent guideline for the iron and steel industry. According to the cost-effectiveness analysis for the guideline, the lowest cost per pound equivalent (of copper) removed was for one of the requirements for hot forming, which had a negative cost of -$0.54 (the negative cost being due to the value of reused scale collected in the control equipment). The highest cost was for sintering, that is, $89.73 per pound equivalent removed. One of the control requirements for hot forming contained in the proposed effluent guideline would have cost up to $1,195.31 per pound equivalent removed.

If such performance standards were not required in each case without either a highly flexible credit system or a phasedown permit system, such costs could not be evened out through market mechanisms. Use of a credit system such as is suggested in the summary section above would provide a means of moderating the highest cost control requirements. Further, they would provide an incentive for technological innovation to find the lowest cost alternatives for all waste streams, since breakthroughs in the control of one waste stream could be used to reduce the costs of controlling other waste streams.

Several other factors should be considered and analyzed in order to more fully evaluate the potential costs of performance standards to industry. They include:

- In estimating the incremental cost of reductions brought about by performance standards, the higher disposal costs created by the land disposal restrictions should be regarded as a cost avoided for each ton of waste eliminated. Thus, the net costs of reductions in waste generation would be significantly lower than the gross costs.

- Credits for recycling could provide some flexibility for performance standards requiring reductions in waste generation. The fluctuations in the market for recyclable materials, however, make any effort to project the benefits of such credits uncertain.[6]

- Delays in the development of standards or in the review of permits create uncertainty. This can add substantially to the cost to industry of a performance standard. Because these standards would generally affect production processes, and not just end-of-pipe controls, the delays and their effects might be even greater than under the air and water programs.

Equity

Performance standards are an unambiguous requirement that the generator reduce the generation of hazardous wastes. The concern that this option is equitable will depend on how it is imposed on the industry. There may be problems with equity if the standards are selective, that is, the standards affect some but not all of the regulated community.

Incentives for Noncompliance

The imposition of performance standards might create a number of adverse effects that might limit or delay the realization of waste minimization goals. Some of the issues of concern are discussed below:

- If performance standards are imposed on the smaller generators in an industrial category for which standards are developed, there may be some effort by these generators to avoid compliance through such measures as underreporting and/or illegal disposal. A report by the General Accounting Office on illegal disposal of hazardous wastes (General Accounting Office/RCED-85-2) indicated the difficulty of discovering and preventing such practices with the limited enforcement resources available. It is likely, however, that small facility exemptions would be allowed, as is the case with many of the air and water standards.

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[6] *Wall Street Journal*, April 14, 1986. Fluctuations in market prices of virgin materials can affect both the potential for resale of recyclable materials and decisions of the generator to reclaim the material for its own use. Dramatic reductions in the price of crude oil, for example, have increased the competitive problems for the recycling of used oil, independent of whether used oil is or is not finally determined to be a hazardous waste. Conversely, a rise in sulfur prices from $36/metric ton in 1977 to $140/metric ton currently, to a projected $200/metric ton in 1987 has resulted in the development of a process for recovering limestone and sulfur from the waste gypsum produced by utilities.

Reclamation and recycling of pickle liquor by steel plants to recover sulfuric acid depends both on market conditions and geographic location. For steel plants located in the Southwest, sulfuric acid can easily be obtained from the copper smelters, which generate the acid from their stack scrubbing control systems. For steel plants in the East, the question of whether it is cheaper to reclaim spent pickle liquor or to buy virgin sulfuric acid will depend on the cost of the reclamation process, the cost of the virgin material, and the net differential in the costs for disposal of the spent pickle liquor and the costs for disposal of the ferrous sulfate residue from reclamation of the pickle liquor.

- Since performance standards requiring reduced generation of wastes are likely to require significant changes in manufacturing processes, with potentially major impacts on both product quality and productivity, the likelihood of litigation is greatly increased, resulting in further delays in the actual realization of waste minimization.
- Since such performance standards would often involve redesigning industrial processes, the effort required is in some respects different in kind from that involved in developing effluent guidelines and air standards. It is not clear that the necessary expertise can readily be found outside of plant management, and this might both extend the time required for the Federal government to develop the standards and increase the uncertainty of the result.

2.3 Implementation Issues

Legislative Authority

A general program of performance standards to achieve waste minimization would require enactment of legislative authority by Congress. As has been noted throughout this report, EPA understands the legislative history of HSWA to specifically prohibit the Agency from defining waste minimization in relation to any particular industrial production process.

Under Section 6(a) of TSCA, however, EPA does have authority for any of a wide range of measures with respect to any substance or waste stream that poses an "unreasonable risk of injury to human health or the environment." Specifically, the Agency may institute "a requirement prohibiting or otherwise regulating any manner or method of disposal of such substance or mixture, or of any article containing such substance or mixture, by its manufacturer or processor or by any other person who uses, or disposes of, it for commercial purposes." This authority could be used for imposition of the waste reduction requirement for specific waste streams that met the "unreasonable risk" criterion.

Time Required for Implementation

Performance standards are likely to require several years for development. Under both the air and water programs, performance standards have generally required about four years each for development, but the more complex performance standards dealing with the largest industrial categories or processes have taken substantially longer. The effluent guideline for the organic chemicals industry has been under development since 1977 and is expected to be finally promulgated at the end of 1986. The NSPS standard for industrial boilers has been under development for over eight years and still has not been promulgated.

Since performance standards for waste minimization would require imposition of standards and limits directly impinging on the processes of production and not simply on end-of-pipe controls, it seems likely that the time required for development would be as long as or longer than for the air and water standards. And if the record of those programs provides any precedent, the larger and more complex the industry for which standards are being developed, the longer the process.

The most plausible timetable for designing and implementing a large-scale performance standards program would be as follows:

- Since EPA currently lacks legislative authority to implement performance standards, new authority would have to be established during the next round of amendments to RCRA. The earliest likely date for this would be 1988.
- Assuming that adequate baseline data have been developed during the intervening period, selection and ranking of candidate industry categories and/or industrial processes would occur during 1989.
- Optimistically, the development of the performance standard requirements by EPA for the first of the selected industrial categories would be completed during the following four to five years (by 1993-1994).
- Implementation of the standards by EPA and/or delegated States, and purchase and installation of new equipment by industry, would

take a minimum of two to three years (perhaps a year less if only good operating practices are required). Thus, the earliest completion date for implementation of a standard would be somewhere between 1995 and 1997.

- Results of the implementation would be visible the following year (i.e., approximately 1996 to 1998).
- For more complex standards, the date by which results would begin to become evident would probably be six or seven years later, most likely after 2003.
- If action on performance standards is delayed until it is possible to track at least the initial effects of the land disposal restrictions on industry waste minimization activities, from one to five additional years would be added onto the process. With the two-year variance, 1988 will be the first year when the initial land disposal restrictions would go fully into effect. The first year's tracking data could then be gathered by 1989. The last of the subsequent land disposal restrictions could go into effect as late as 1992.

Appropriate Target Industries

Performance standards for waste minimization would be appropriate for those industries that produce high volume and/or high toxicity waste streams and that continue to represent, after the imposition of the land bans has been completed, a serious risk to human health and the environment.[7]

An evaluation would first be required to determine whether there are economically feasible technological alternatives to current industry production and/or recycling practices.

Industries using batch rather than continuous processes, for example, are likely to be more difficult to control, even where total volumes are high. In some cases (e.g., solvents), treatment by incineration may be more effective and less costly than alternative source reduction approaches.

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[7] Such an evaluation should take into account industry practice with respect to recycling and onsite incineration, since these practices may significantly reduce any risks created by the initial generation of a waste stream.

According to the data currently available,[8] the organic chemicals industry (SIC code 2869) is the largest source of the most toxic hazardous wastes. A recent survey by the Chemical Manufacturers Association indicates that the chemical industry has made substantial reductions in hazardous waste generation since 1981.[9] Much of this reduction appears to be the result of concerns for liability by the large firms that dominate production and waste generation in the industry. In addition, process changes to maximize efficiency in use of raw materials are more cost effective in the largest chemical facilities. A separate study by INFORM (*Cutting Chemical Wastes*), however, claims that the chemical industry has made little progress toward waste minimization. "The millions of pounds of waste reduction reported by the study plants is only a minute fraction of the total wastes generated by them."[10] EPA currently lacks a data base that would enable it to determine exactly what kinds of changes in waste generation have occurred within this industrial sector.

EPA's technical background report on waste minimization developed for EPA reviewed several industrial processes included in the organic chemical manufacturing industry, including acrylonitrile manufacture, epichlorohydrin manufacture, 1,1,1—trichloroethylene perchloroethylene manufacture, and vinyl chloride monomer manufacture. Each of these manufacturing processes is carried out in a small number of very large plants. While these processes produce large volumes of wastes, the engineering analysis concluded that these facilities have significantly minimized wastes. There are still opportunities, however, for small proportional changes that could be substantial in volume.

Many of the waste streams generated by chemical manufacturers are among the first to be subject to the land disposal restrictions. This will create a substantial additional incentive for plants to reduce waste generation, recycle, or incinerate their waste streams. It will take some time to determine the impact of these new regulations. That determination will be further delayed where variances of up to two years are granted because of inadequate treatment capacity.

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[8] See summary on waste generation data in Chapter 2.

[9] Chemical Manufacturers Association, January 1986, *Results of the 1984 CMA Hazardous Waste Survey*. The survey found a 16 percent decrease in the generation of hazardous waste between 1981 and 1984, and a 34.8 percent reduction in the volume of hazardous solid wastes sent to landfills.

[10] INFORM, *Cutting Chemical Wastes*, p. 31.

Other industries with waste streams identified as highly toxic include dry cleaning and paint manufacturing. Once again, however, the waste streams involved—tetrachloroethylene distillation residues from dry cleaning (F002) or spent methyl ethyl ketone solvents from paint manufacture (F005)—are subject to the first phases of the land disposal restrictions, and practices may change as a result. In addition, although it is assumed that the dry cleaning industry recycles a large portion of its solvents, available data are not adequate to determine the precise extent of this practice or current trends.

An industry's suitability as a target for performance standards may also depend on available centralized treatment and/or recovery capacity. The electroplating industry, for example, produces large volumes of metal-bearing sludges. Since most electroplating facilities are quite small, substantial process changes to reduce waste generation are not likely to be financially feasible. In New Jersey, Minnesota, and Illinois, however, feasibility studies are under way on the possibility of constructing central ion exchange metal-recovery waste processing plants to which electroplaters could send their wastes. The existence of such a facility would make possible a degree of waste reduction and recycling that could not otherwise be achieved by these facilities. Where such facilities become available, the imposition of recycling and more stringent waste reduction requirements might be feasible.

Costs of Development and Implementation

Until the scope and design of a performance standard program is determined, it is not possible to develop accurate estimates of the costs to government of developing a full-scale performance standard program. The best means of getting a perspective on those costs is by looking at the cost of developing the performance standard programs required by the Clean Air Act and the Clean Water Act.

According to estimates of staff at OAQPS, the cost of development of an individual NSPS or NESHAPs standard will generally vary from a low of $1 million to a high of $5 to $10 million, and require from four to eight or more years to complete. An analysis done by the Industrial Technology Division in the Office of Water indicates that the total cost of development of the effluent guidelines program from 1973 to 1986 was about $300 million (in 1984 dollars). The cost of developing one of the most complex guidelines, that for the organic chemicals industry, was about $15 million.

Assuming the development of performance standards for a single waste stream within an industry sector or across industry sectors, using the authority under TSCA, Section 6(a), the costs for single standards under the air program would probably provide the closest analogy to what would be required.

Government implementation costs include the development and operation of a permit program as well as resources expended at both the Federal and State levels. As in the case of the air and water programs, a reasonably comprehensive performance standard program would require the permitting of most of the 43,000 generators throughout the country (excluding small quantity generators). The largest part of this effort would be delegated to the States. The cost would depend on the scope of the program.

The 1984 Report to Congress, *The Cost of Clean Air and Water*, provides some figures on the implementation costs of the two programs at both the Federal and State levels. Federal costs (actual or projected) for administration of the air program from 1971 to 1984 (in 1981 dollars) were $1,955 million, of which $1,094 million comprised grants to the States (which would be used for all State air program costs). Additional expenditures by the States during those years amounted to $2,412 million (which, again, would include administration, enforcement, and all other facets of air program costs). For the effluent guidelines permitting program, which is delegated to the States, State expenditures during the period amounted to $3,169 million (which includes all State water program costs).

A performance standard program would impose enormous additional costs on the States. Implementation of the air and water programs had been heavily assisted by Federal cost sharing, but Federal assistance has been cut back over the last few years. It is not clear whether, given the current Federal budgetary constraints, similar initial support could be expected for implementation of a waste minimization performance standard program. Imposing a program without providing for a major share of the cost to be picked up by the Federal government would create an enormous burden for the States. It might even cause many States to reconsider the feasibility of implementing and managing the hazardous waste program at the State level.

Other Issues

Enforceability: A performance standard program would result in the development of permits for specific levels of waste generation from the regulated processes within each facility. The permit provides a clear legal benchmark against which enforcement action could be taken. Where the standards are based on waste generation per unit of production, standard documentation of production levels would generally be available against which performance could be evaluated. If credits for over control or recycling are allowed, the burden of proof would be on the generator to demonstrate that those credits are available and allowable.

While some elements of enforcement would thus be straightforward, others cause difficulties. To the extent that the standards might be inflexible and/or extremely stringent, there might be an incentive for some generators either to attempt illegal disposal or to escape inclusion in the system (although this is more likely to be a problem with small quantity generators, who could be exempted from performance standard requirements). This problem would be compounded by the enormous number of generators and processes that could potentially require enforcement. Substantial new resources for enforcement would need to be appropriated if such a program were not to become unenforceable.

Enforcement costs for performance standards would involve visiting the sites and reviewing the paperwork to determine whether the required concentration of volume limitations for each waste stream is being achieved. Conservatively, this would be likely to require, at an average plant, a minimum of 1 to 1.5 person-days for enforcement personnel for the site visit, followed by an additional 1 to 1.5 days for analysis, further review of records, and follow up.

A possible cost estimate can be developed from this by assuming that enforcement inspections would be carried out annually for 10 percent of all generators other than small quantity generators (or approximately 4,300 generators annually), requiring approximately 56 additional enforcement person-years. With support staff, salary and other costs, this would require additional annual costs well in excess of $5 million. (If small quantity generators were included under the requirements, even a one percent inspection frequency would add 1,750 enforcement inspections. Even assuming these took only half the time of other enforcement inspections, this would require another $1 million.)

Public perception: Performance standards can have the positive effect of being generally acceptable to the public. Performance standards provide clear evidence of the effort being made to clean up the environment. This positive public perception might, however, be tempered by the possibility of adverse economic or employment effects.

Information: The gathering of information by the government and its subsequent use in the development of performance standards can raise serious legal questions about confidentiality with respect to proprietary information. Alternative processes used by a company to manufacture a given product may be a major reason for that company's comparative advantage in the market. A proprietary process that reduces raw material inputs or makes more efficient use of those inputs may be the basis for a company's being able to undersell others in the market. It might happen with some frequency that a firm will be very reluctant to divulge any information about its processes to the government.

3.0 Recommendations

Under certain circumstances and conditions, performance standards might be a desirable and feasible method for minimizing waste. As was the case when performance standards were mandated by the Clean Air and Clean Water Acts, substantial economic and legal pressures must be overcome before a performance standard for waste minimization can be implemented. Given current data and evidence, it is uncertain at this point what progress will be achieved in waste minimization from other Agency activities and regulatory policy and where there will be gaps in regulation that might be filled by performance standards. Because of the uncertainty of the situation, the following steps appear appropriate:

- Between now and full implementation of the land disposal restrictions scheduled under HSWA by 1990, comprehensive data should be developed to make possible an evaluation of trends relevant to waste minimization. These data and information could be gathered through the Comprehensive Assessment Information Rule (CAIR) system authorized under Section 8(a) of TSCA and currently being developed by the Office of Toxic Substances and through information derived from a redesigned waste minimization section in the biennial report. This effort should focus on obtaining:
    - More adequate baseline data with respect to toxicity and volume of waste streams, by industry and process category, geographical area, and plant size;
    - Trends in these figures over the next several years;
    - Changes in recycling and treatment practices with respect to the various combinations of these factors; and
    - Changes in manufacturing processes that result in reduced generation of waste.
- The above data should be evaluated to identify changes and trends in waste generation and minimization. Appropriate reduction requirements could then be mandated with respect to the specific waste streams or industry sectors that have not minimized wastes to the extent desirable and economically feasible. Requirements could also be mandated for specific waste streams that pose significant environmental or human health hazards.
- After the land disposal restrictions are in place, their effects should be evaluated. The contributing effect of liability concerns should also be examined. The following types of problems should be assessed: (1) waste streams that are still causing environmental problems despite the imposition of land disposal restrictions and (2) industry sectors whose generation of these or other wastes are causing environmental problems. Those waste streams and/or industry sectors that fall under the above two criteria should be further examined to determine whether technological alternatives to current industry production processes exist and whether performance standards are appropriate. If performance standards are found to be appropriate, it would be preferable to develop standards that maximize flexibility (and thereby minimize impact on the actual production process) for the generator by:

  - Permitting credit for recycling;

  - Permitting credit, in some circumstances, for onsite incineration; and

  - Permitting over control of one regulated waste stream to be credited against under control of another waste stream in the same plant or at other plants (with credit limited to use for wastes in the same or a lower toxicity class).

- Where specific hazardous waste streams are identified as causing potentially critical environmental problems or health risks between now and 1990, specific performance standards for these waste streams could be developed under Section 6(a) of the Toxic Substances Control Act (TSCA).[11]

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[11] Section 6(a) of TSCA allows EPA to impose restrictions on the manufacture, processing, use, or disposal of chemical substances. It specifically gives the Agency the authority to impose "a requirement prohibiting or otherwise regulating any manner or method of disposal" of a chemical substance or mixture. These authorities are all contingent on a finding that, unless such restrictions are imposed, the substance "will present an unreasonable risk of injury to health or the environment." Relatively few actions have been proposed or promulgated to date under this section. The substances regulated or proposed for regulation have been asbestos, chlorinated fluorocarbons (CFCs), dioxins, formaldehyde (ANPR), methylene chloride (ANPR), and metal working fluids.

Prohibit or Restrict Generation of Specific Wastes

1.0 General Summary

Under this type of performance standard, EPA would be able to ban or otherwise restrict the manufacture, processing, or distribution of a chemical substance that poses unavoidable human health and environmental risk. This option is distinctive for three reasons. First, it differs from other more conventional performance standards because its objective is to completely prevent the waste from being generated. Other types of performance standards impose reductions through various methods, but are not specifically oriented toward total elimination of the waste.

Second, the determination to prohibit or restrict a particular waste will be based in part upon the feedstocks responsible for generating a waste, rather than simply on the waste stream itself. More than any other option it is necessary to carefully evaluate the feedstocks responsible for generating the waste under consideration, since prohibiting or restricting the particular waste could have dramatic implications for industry. On the other hand, this option might stimulate new and innovative approaches to resolving or minimizing waste generation. It could also encourage better technical approaches toward reducing waste generation because of the nature of substances being banned or restricted and the incentives to develop substitutes. However, where production processes cannot substitute feedstocks in order to avoid generation of a prohibited or restricted waste other options might be better candidates for minimizing waste. Otherwise, the industry using the process might have to stop production altogether. In this regard, it may be more appropriate and logistically feasible to prohibit or restrict the feedstocks responsible for generating the waste streams than to prohibit or restrict the waste itself. Prohibiting or restricting feedstocks for production of a particular process could, among other things, reduce the possibility of noncompliance and improve the monitoring and enforceability of this option.

Third, this option is product oriented. Some products, when used, might result in a waste that is under consideration for prohibition or restriction. It might thus be necessary to find substitute products in order to avoid the generation of the particular waste. For example, methylene chloride as a paint stripper generates a hazardous waste stream. Instead of prohibiting or restricting the waste another method of paint stripping such as bead blasting might be used as a substitute thereby not generating the same waste.

The option can be implemented for the most part on a waste stream-specific basis. Occasions would arise, though, for prohibiting or restricting wastes on an industry-specific basis. Finally, the option can also lend itself to negotiated compliance schedules, similar to the phase–out of asbestos and lead in gasoline.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

While more data are needed to fully assess of its volume-reducing potential, the effectiveness of this option is dependent upon the substances involved, their prevalence in industry, the wastes associated with their use, and the degree to which substitutions can be found. Prohibiting or restricting a particular waste will drastically reduce its volume. Under certain circumstances there is the possibility that this option may result in increases in the volume of waste discharged to other media. This option might actually have a greater impact on the reduction of toxicity than a reduction in volume.

Toxicity Reduction

There is a significant potential for reduction in toxicity; however, like volume reduction, there is little information available to fully evaluate the impact on toxicity. By prohibiting or restricting the generation of specific wastes, industry will have an incentive to seek out less toxic and persistent feedstocks to use in products. Alternatively, where there is a threat of a future prohibition or restriction on generating wastes, industry may take the initiative and develop improved treatment processes. For example, the pesticide manufacturing industry may develop more easily detoxified pesticides.

Other Technical Effectiveness Issues

Measuring Results: Some form of monitoring would be necessary in order to assess the ability of this option to achieve the waste minimization objective. The option could be measured by requiring firms to keep inventories of the substances used in processing and manufacture, similar to the requirements of right-to-know laws. TSCA can require that such records be kept. Resulting reductions of waste can then be tracked through the RCRA reporting mechanisms, i.e., biennial report data, manifests, and future RCRA surveys.

2.2 Impacts on Industry

Economic Impacts

Initial capital investments for alternative production processes are likely to be high. Costs would be low for user industries able to substitute raw materials or feedstocks.

Since the option would result in a retooling of some plants, operation and maintenance costs could be a problem if additional personnel and/or expertise are needed to implement changes.

Equity

Some companies within a given industry might be affected more severely than others; however, more data are needed to assess this issue. For example, manufacturers of certain types of pesticides would be severely affected by a ban on the generation of waste materials associated with their production. Manufacturers of competing compounds would probably gain an increased market share as a result of such regulations. It is anticipated that larger companies would be better able to shoulder the costs than would smaller companies. Problems may arise if the waste material to be restricted from generation is produced entirely by small companies with limited product lines.

Another equity concern is the impact that this option would have on U.S. industrial competitiveness. Foreign producers who may have less stringent waste minimization requirements may have an advantage over U.S. manufacturers of the same product.

Industry might protest this option on the grounds that government is intruding into private manufacturing processes. Although industry maty have some incentive to develop product substitutes or alternative processes, it is highly unlikly that such would always be the case. Where proven substitutes are readily available, the regulated community might rapidly switch feedstocks to avoid new regulations. For example, pesticide formulators would handle and formulate new products having an effectiveness similar to the banned produces if regulations restricting generation of particular pesticide wastes are enacted.

2.3 Implementation Issues

Appropriate Target Industries

At present, data are not sufficient to designate appropriate target industries.

Incentives for Noncompliance

The possibility of noncompliance could be significant for this option. If the waste stream is prohibited or restricted from generation, facilities unable to develop substitute feedstocks, other products or alternative treatments for the waste stream will be confronted with two choices (1) to close down operation of the process, and perhaps the business as well, or (2) to continue production and generation of the prohibited waste. Facilities that choose to continue to produce the prohibited or restricted waste will be faced with disposing of this illegally generated waste. If, instead of wastes, feedstocks or products are prohibited or restricted, a facility would have fewer incentives not to comply. It would be unlikely that the facility could be able to obtain the prohibited or restricted feedstock and thus it would not be put into a position of producing the waste stream. For example, chlorinated fluorocarbons, a feedstock which at one time was commonly used in aerosols, is now banned. A facility is therefore not likely to use chlorinated fluorocarbons illegally in aerosol production, since the ingredient is unavailable.

Legislative Authority

EPA could use its power under Section 6(a) of the Toxic Substances Control Act (TSCA) to ban or otherwise restrict the manufacture, processing, or distribution of a chemical substance, or to regulate "any manner or method of disposal" or any chemical substance or mixture that "presents, or will present an unreasonable risk of injury to health or the environment." One example of the use of Section 6(a) authority is the ban on manufacture for most uses of chlorinated fluorocarbons for aerosol propellants.

Time Required for Implementation

Because implementation of this option will require some collection and analysis of data, it is estimated that approximately two years will be needed to identify industries, processes, and substances to be targeted. Time will also be required to set up the option and draft the regulations. Depending on the volume of wastes associated with particular production processes, it may take from three to five years for the effects of this option to become visible. For other processes, the results may not be readily apparent. For instance, if chrome plating of auto bumpers were banned, the resulting reduction of chromium wastes would be hard to detect because other chrome plating operations are still being practiced.

Costs of Development and Implementation

Data are insufficient at this time to estimate the overall cost of this option, although it is possible to determine the approximate cost of some factors such as enforcement. To determine costs, data should address industry's behavior under the authorized land disposal restrictions, under certain State waste-end tax regimes, and under other relevant programs. Information is also needed on the success of particular procurement programs that are implemented by some government agencies, such as the Department of Defense.

Enforcement activities for prohibiting or restricting generation of specific wastes would be fairly straightforward. A site visit, a review of records, and, in some cases, the evaluation of a sample from a waste stream would be required. At an average plant, the site visit and sampling would require about 1 to 1.5 person-days for enforcement personnel, followed by an additional 1 to 1.5 days for analysis, further review of records, and followup. The total effort involved might increase if more sampling is required.

A possible cost estimate can be developed by assuming that enforcement inspections would be carried out annually for 10 percent of all generators other than small quantity generators (or 4,300 generators annually), requiring approximately 33 additional enforcement person-years. With support staff, salary, and other costs, this would mean additional annual costs well in excess of $3 million. (If small quantity generators were included under the requirements, even a 1 percent inspection frequency would add 1,750 enforcement inspections. Even assuming these took only half the time of other enforcement inspections, this would require about $1.5 million.

Coordination with other agencies may also be necessary to improve the effectiveness of this option. It is unclear at this time what level of coordination will be required or what the costs associated with the coordination will be. For example, banning certain pesticides which are difficult to detoxify might have to be coupled with approval of alternative products for pest control. This may require coordination with other Federal agencies such as the U.S. Department of Agriculture.

The cost estimates should also include staffing requirements for the implementing office as well as the costs for analysis of the results. The costs would probably be similar to programs run under TSCA, in particular, the programs for banning PCBs and chlorinated fluorocarbons in aerosols. The cost of the analysis required may be similar to the level of effort expended for the technical support document on waste minimization or other similar studies.

There would probably be few costs associated with Federal or State agency interaction, since implementation of this option would not be mandatory in order for this option to work. The program could be run autonomously by the Federal government in the same fashion as are the bans on polychlorinated biphenyls (PCBs) and chlorinated fluorocarbon (CFC). The option also would not be likely to conflict with State programs.

Other Issues

Information: One of the major handicaps to a full evaluation of this option is the lack of important information. In order to better understand the implications of this option a number of other issues must be taken into consideration, including:

- Identification of substances and processes that cause the generation of particular waste streams.
- Identification of industries and/or processes that use such substances.
- Identification of substitute materials that could be used in place of materials that cause the waste stream.
- Identification and evaluation of process changes that could be implemented in support of banning or restricting particular wastes, either on an industry-wide or waste stream basis, or on a process-specific basis.
- Identification of products used, the production of which may result in the generation of hazardous wastes, and the use of which may result in disposal of product (or its residual) in Subpart D landfills. (For example, styrofoam products may degrade into toxic constituents.)
- Identification of substitute products for those identified in the previous item above, that would result in reduced or zero generation of hazardous wastes, or generation of wastes that are less toxic or more easily detoxified.
- Measurement of changes in air and water effluent levels. This could probably be done in conjunction with a mass balance reporting requirement.

Public Perception: Unlike some schemes in which "the polluter pays," this option may result in the consumer paying. If prohibition or restriction results in substitute products that are more expensive than the original, the consumer is forced to pay the difference. To some degree, market competition factors may keep prices at a reasonable level. Aerosol products, for example, do not seem to be appreciably higher now than before CFC was banned.

The general public would probably accept this option since it appears to reduce health and/or environmental risks. On the other hand, the option has the potential to threaten employment. Since product substitution may result, there is always the possibility of layoffs or temporary shutdowns until the particular industry(s) affected is able to re-enter the market place via introduction of alternative products. Thus, the option creates incentives for new industries, which could increase jobs through the need for alternative processes and substitute products.

3.0 Recommendations

This option would be an extremely powerful tool with which to control hazardous substances. It is probably the most direct application of a source reduction regulatory program and has the potential to reduce the generation of specific wastes if used properly. Certain conditions must be met before the option could be considered desirable, however.

Since this option is expected to have a more dramatic impact than others, it should not be implemented until these other options have been analyzed and those waste streams that are the most appropriate candidates have been specifically identified. Careful analysis of the waste streams and processes involved must be performed in order that imposition of the option will achieve its objective most efficiently. Where the prohibition or restriction of a waste stream leads to product or feedstock substitution, or stimulates new and innovative treatment technologies, it might be appropriate to impose the option. However, where it appears unlikely that industry will find substitutes or new treatment technologies and therefore will be forced to terminate the production process, it will be critical to assess whether the improvement in human health and the environment will offset the other expected impacts from implementing the option.

This option should be the last resort for stimulating waste minimization. It would be appropriate only when the following conditions are met:

- The waste streams under consideration are extremely toxic;

- EPA is convinced that current management practices cannot overcome unacceptable levels of risk from waste generated in their facility; and
- When other waste minimization measures have failed.

Waste Generation or Management Phasedown Permit Program

1.0 General Summary

This approach to waste minimization would involve a variation on the concept of marketable permits. A marketable permit regulatory program for hazardous wastes would create transferable rights via permit stipulations limiting the total volume of hazardous waste that industry could either legally produce or manage. It is a form of mandatory standards of performance because it would impose specific waste generation limits either directly on source generators, or indirectly on those who treat, store, or dispose of wastes. In a phasedown permit scheme, permits would be reissued from time to time with the total amount of waste allowed for all permits being reduced ("phased down") with each reissue. Trading among permit holders would be allowed as in any marketable permit system.

While the marketable permit concept has not yet been widely applied, there are a number of precedents suggesting that its use as a vehicle for reducing hazardous waste generation might be effective. These include several EPA applications as well as a variety of examples from other agencies and levels of government.

Since 1976, EPA has successfully implemented approaches resembling phasedown permits in emissions trading, where concern centers on controlling aggregate levels of ambient pollution allowed rather than on controlling specific geographic or source distributions. The "bubble" allows the creation of surplus reductions beyond those legally required at certain emissions sources to compensate for excess emissions at other existing plants or groups of nearby plants. Emissions trading allows States and sources (1) to "net out of" preconstruction reviews for new plants or plant modernizations where plant-wide emissions will not increase by significant amounts; (2) to offset modernization or expansions in nonattainment areas by securing extra reductions from nearby firms; and (3) to store or "bank" qualified emissions reduction for later use in bubble, netting, or offsetting transactions. Banked emission reduction credits (ERCs) can also be sold or leased to firms seeking alternative ways to meet regulatory requirements more quickly and flexibly. To be used in trades, any reduction credits must be surplus (i.e., beyond current legal requirements), permanent, enforceable, and quantifiable. Effectively implementing such trades requires the establishment of emissions baselines while avoiding double counting reductions that have already been taken into account in area-wide air quality attainment plans. However, because plant-specific emissions must be quantified with precision in order to engage in an approvable trade, individual bubbles can improve the quality of such plans. Similarly, because potential savings from bubbles can occur, they also can improve compliance and enforcement due to trading and willingness to agree to invest in advanced compliance methods (e.g., continuous emissions monitoring) in order to obtain them. Since EPA issued its comprehensive Emissions Trading Policy Statement in April 1982 (47 FR 15076) about 100 existing-source bubbles involving an estimated "average savings" of $3 million each have been approved by the Agency in delegated States, with another 100 under development for total estimated savings of about $1 billion over the cost of conventional, source-by-source pollution control. In 1985, EPA proposed to extend this bubble approach to new facilities subject to stringent New Source Performance Standards under Section 111 of the Clean Air Act, noting that the single trade proposed for approval would yield estimated savings of up to $25 million per year, and additional emissions reductions of 3,000 tons per year over traditional stack-by-stack compliance (50 FR 3688).

In a second example, EPA has also proposed the use of marketable permits for restricting chlorofluorocarbons. In this case, EPA compared the potential cost of a mandatory control system to the potential cost of a marketable permits program. The comparison showed that the permits program would be less costly overall. Nevertheless, the expected transfer payments from consumers to industry turned out to be unexpectedly large. The transfer payments reflected higher product prices which, in the aggregate, was estimated by an EPA consultant to amount to $1.7 billion, or about 16 times the incremental control costs.

EPA has also proposed a program to allow the banking, transfer, or trading of asbestos mining and importing permits during a ten year phase down of asbestos production. Under the proposal, miners and importers would apply for permits that would restrict asbestos use to 30 percent of EPA's base period volumes in the first year and phase down use by 3 percent per year over the subsequent years. Only those applying for permits would be granted permits. Firms could enter the market by obtaining a permit from a current holder. EPA is also considering acting as information liaison between parties.

Another example of government use of marketable permits is the Federal Aviation Administration's adoption in early 1986 of a scheme for more efficient and flexible allocation of landing and departure slots at high density airports. In this case the FAA established a system wherein 15 percent of available slots were saved for new entrants, with the remaining slots "grandfathered" to existing users. The administrative plan includes a "use or lose" provision by which slots not used 65 percent of the time over a two month period revert back to the FAA for reallocation. Although the initial allocation of slots is free of charge to carriers, the carriers may buy, sell, or lease slots to suit their needs. By June of 1986 there had been about 15 transactions under this program. This has raised concern in Congress over potential windfall profits—carriers obtained the slots at no cost, but can sell them for a substantial profit. For this reason, Congress is considering a bill to repeal the FAA's rule. In the meantime, Texas Air recently sold three gates and 32 slots at La Guardia Airport to Pan Am for $65 million.

A third example is that of taxi service in New York City, wherein cabs are required to have "medallions." Medallions are in effect a form of marketable permit which owners can buy and sell on the open market. The city established a fixed supply of medallions allocated to preserve the historic distribution between fleets and individual owners. The city does not allow transfers of medallions between categories.

EPA has already fully instituted or considered regulation schemes resembling phasedown permits for certain air pollutant emissions trading, reduced lead content in gasoline, asbestos mining, and chlorofluorocarbon (CFC) reduction. These experiences can inform current deliberations on phasedown permits for hazardous waste minimization.

In at least one important way, the end point of a phasedown permits program is like a performance standard mandating waste reduction: both allow EPA to decide in advance the maximum quantity of waste which can be generated per unit of time (e.g., one year).

Permits would then be issued either to generators or waste treatment, storage, and disposal facilities (TSDFs) for this volume of waste.

Phasedown permits, however, differ from performance standards in many important ways. Most important, they potentially cost society less for achieving a given level of waste reduction. This is because phasedown permits can be transferred (bought, sold, leased) in an open market system. The degree of incentive for trading is primarily dependent on variations in control costs within the participating group of firms; if variations are high (i.e., if some firms can reduce wastes much less expensively than others) then there is an incentive for permits to be transferred. If variations in control costs are small, then there will be few if any trades, and the system will not be any less costly to society than a conventional command-and-control type of performance standard.

For example, assume there are only two producers of a given waste stream. Each manufacturer produces ten tons of waste, and that it would cost producer A $3 per ton to reduce his waste, while producer B would incur $30 per ton to reduce his waste. If a performance standard required a 50 percent waste reduction so that each had to reduce waste by five tons per period, then the two firms would have total costs of $165 ($3 x 5 tons plus $30 x 5 tons). If, however, it is only important that society obtain a total reduction of 10 tons (50 percent), *independent of where the reduction occurs*, then a phasedown permit system in which permits for only 10 tons of waste production were issued would achieve the same environmental goal at lower costs.

Assume, for purposes of illustration, that EPA makes an initial allocation of permits at the rate of one permit per one ton of waste, with each firm allowed to receive five permits. Firms A and B have the option of then reducing each of their respective waste streams by 50 percent, as would have occurred under the scenario of the performance standard. They also have other options open to them, since they can negotiate with each other to obtain more permits. As stated above, it is more expensive for Firm B to reduce waste than for Firm A. Both firms would like to continue producing 10 tons of waste apiece, but that is no longer allowed, and it is highly unlikely that either of them could achieve or be willing to achieve a zero waste production rate. Firm B may be willing to produce 8 tons of waste rather than 10. Since Firm B already has been issued five permits (thus allowing it to produce 5 tons of waste) it would need three additional permits. These three permits could be purchased from Firm A, if that firm were able to reduce its waste by three tons.

Assuming that Firm A reduces its waste by three tons (resulting in a net waste production of two tons), it could then sell three permits to Firm B. As stated above, Firm A can reduce its waste at $3 per ton. It would thus be willing to produce three tons less waste if it could sell its permits for any amount more than $3 per ton. Firm B would be willing to pay any amount up to $30 per ton since it could save money at these prices.

When both firms are aware of each other's position, Firm A will want a price as close to $30 as possible, while Firm B will want the price as close to $3 as possible. This example assumes that only these two firms exist, so that the normal forces of supply and demand competition cannot be applied to arrive at the negotiated price. The total cost to society can be calculated, however, because the cost of reduction is still $3 per ton for wastes reduced by Firm A and $30 per ton for wastes reduced by Firm B, regardless of the permit price. The total cost to society is thus ($3 x 8 tons) + ($30 x 2 tons), or $84—approximately 50 percent of the control cost under the performance standard scenario.

A system of phasedown permits can be structured in many ways depending on the nature and terms of the permit (e.g., who gets them—generators or disposers?); the initial allocation scheme (e.g., are current users "grandfathered"?); and the type and extent of government involvement in the permit market (e.g., does EPA serve as banker or broker as well as enforcer of permit limits?).

To implement a phasedown permits system, EPA must first decide what to allow. If permits were issued to generators, each permit, like a performance standard, would allow its owner to generate up to a given amount of hazardous waste per year, as measured in volume or toxicity in different waste streams. Alternatively, permits could be issued to treatment, storage, and disposal facilities rather than to generators. The permit would then allow its owner to treat, store, or dispose of a certain volume (or volume weighted by toxicity) of hazardous waste per year. Since the allowed volume of waste would be less than current volumes, the TSDFs would raise the prices charged to generators. The permit could be permanent or temporary, with terms from one year to ten years or even longer, with perhaps some fixed amount within each year or other restrictions on permit use. A permit system could also combine these two approaches (e.g., by issuing 10 times more treatment permits as disposal permits). Generators, in turn, would have a greater incentive to find ways to reduce the waste they produce.

Once the nature of the permit is decided, the next requirement is an initial allocation scheme. There are two practical ways to structure the initial allocation: through an auction or through "grandfathering." In an auction, the permits would be sold at a market clearing price. Under grandfathering, all current generators (or TSDFs) would be given permits for a certain percentage of their current waste generation. Generators with high waste reduction costs could then buy extra permits from generators with low waste reduction costs, as shown in the example above.

Since owners could buy and sell permits, EPA's choice of an allocation scheme should not affect the final cost to society of the waste minimization desired, i.e., waste reductions would take place where they cost least, and permits would be used to generate and dispose of wastes having the highest costs of management. The allocation scheme would, however, determine the total amount of transfer payments (i.e., transfers of income that result from either giving away or selling permits). Unless taken into account prior to implementation, transfer payments could be very large, as mentioned already in the CFC control case.

The third aspect of a phasedown permit system is the extent of Agency involvement. Government could act only as an information broker by helping generators find sellers or buyers and by explaining the nature of the permit and the market price. Alternatively, it could act as a certifier, banker, and enforcer of market transactions. Finally, government could choose to be a gatekeeper, directly involved in approving all market transactions.

Unlike taxes, which in theory may produce the same results, transferable permits directly limit the amount of waste to desired levels, rather than depending on prices, which may entail inordinate amounts of information, frequent adjustment, and allegations that generators are being allowed to "pay to pollute." From the perspective of social cost, phasedown permits are the least expensive way, to attain a given waste minimization goal, so long as permit holders do in fact engage in cost-minimizing transfers. If they do not, the system would still be as effective as a performance standard mandating the same percentage of waste reduction. EPA has implemented several marketable permit strategies, as have other Federal agencies and local governments, and has proposed to implement several others.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

Since EPA can specify the maximum allowable volume of hazardous waste, phasedown permits should be effective in achieving volume reduction of hazardous wastes, whether permits are offered to generators or TSDFs. This option would also be economically efficient in that the waste reduction would come from generators with the lowest cost for source reduction or recycling.

This option would also provide many generators with additional economic incentives to develop new technologies that lower the costs of source reduction and recycling. If generators receive permits and can produce less hazardous waste, they can sell unneeded excess permits. Likewise, if TSDFs receive permits, generators would be faced with even higher costs of offsite management, thus providing a further incentive to reduce waste volumes before treatment or disposal becomes necessary. However, issue permits to TSDFs might raise questions about further restrictions on treatment capacity rather than direct waste minimization at the source, especially during periods where other traditional alternatives (e.g., land disposal) are also being substantially restructured.

Toxicity Reduction

In general, the phasedown permits option is most easily aimed at volume reduction for hazardous waste streams. Wastes could be classed or rated by their toxicity, but this would add an additional layer of complexity to the system that would restrict the size of markets within which trades could occur. In addition, if the system allowed cross trading among classes of wastes, risks could actually increase.

2.2 Impacts on Industry

Economic Impacts

Assuming significant variation in individual firms' control costs, and assuming that actual trades are made, phasedown permits would cost industry and society less than either performance standards or a ban on recyclable wastes. Generators who have the lowest cost for source reduction or recycling will sell their permits to generators with higher costs. Generators with low costs for reducing waste will reduce their waste and sell their new valuable excess permits to generators with higher costs. Thus, unlike a performance standard, firms have a strong incentive to generate additional reductions beyond those mandated because this creates a valuable resource for them to sell or lease in the marketplace.

Equity

Phasedown permits would entail substantial transfer payments. As EPA learned from its proposal to establish marketable permits for CFCs, transfer payments are not popular with the losers, and may even be unpopular with those who reap the benefits of the transfer. If the government sells the permits at market prices, the transfer payments would be from generators with high recycling or source reduction costs to the government. If EPA issues permits in proportion to current volumes, the transfer payments would be from generators with high recycling or source reduction costs to generators with low recycling costs, or, what may or may not be the same, from firms who have already reduced volume/toxicity to those who have not. Although the distributive effects are different depending on the allocation scheme, any scheme potentially creates big winners and big losers. If EPA were to use a grandfathering allocation and issued permits in proportion to current waste generation volumes, generators who have already taken the initiative to recycle and reduce their wastes would be penalized. Allowing an appeal procedure for generators to show that they have already significantly reduced volumes could alleviate this inequity but could create a substantial administrative burden.

In spite of the foregoing, phasedown permits would be more acceptable to some generators than performance standards because they allow generators to get credit for initiatives that increase efficiency and lower reduction/recycling costs. However, the degree of acceptability among generators may vary considerably depending on the nature of the permit, their control costs, and the initial allocation scheme. Current generators may prefer grandfathering since this is the least disruptive to the status quo. EPA could lessen resistance to an auction of permits by rebating the revenues in a way that does not distort firms' decisions, although there is some inevitable conflict between EPA waste minimization objectives and current industry behavior. EPA could also implement a limited auction (e.g., grandfathering a portion and auctioning the rest).

Incentives for Noncompliance

As with any additional regulations, a phasedown permit system may encourage illegal dumping of hazardous wastes by generators unwilling to purchase the necessary number of permits. If this approach were adopted, it would be crucial to create ways to accurately measure permitted waste volumes. Also, if permits were allocated in proportion to current waste volumes, there would be an incentive for generators to inflate statements of current volumes or to increase their waste generation in anticipation of the market. (In an auction distribution system there would be no over reporting incentive.) In general, phasedown permits would create a whole new industry, including brokers to make the system work. If EPA takes this role, illegal activities would be of less concern.

If, however, phasedown permits were issued to TSDFs rather than to generators, the related enforcement effort applies to both generators and TSDFs. Generators, faced with diminishing capacities and high prices for waste management options, may be encouraged to dispose of their waste illegally. EPA must then allocate its enforcement resources to both groups—to the generators to ensure that they do not illegally dispose of wastes, and to the TSDFs to ensure that they do not treat or accept wastes in excess of what is allowed by their phasedown permits. Issuing the permits to TSDFs rather than to generators would present EPA with a more difficult enforcement task, and could result in more illegal dumping because of a decrease in enforcement efficiency. On the other hand, if phasedown permits are issued only to generators, EPA's enforcement effort could be confined to the generators, ensuring that they do not exceed their permits and do not illegally dispose of their wastes.

2.3 Implementation Issues

Legislative Authority

EPA may need additional legislative authority, depending on allocation scheme, to implement the program broadly and effectively. In the case of CFCs, EPA generally believed that they lacked legal authority to auction permits, but that they could distribute them based on historical waste generation patterns. Given recent unfavorable Congressional reaction to the concept of letting the market set a price for landing slots at congested airports, EPA would be prudent to seek legislation specifically allowing the Agency to implement phasedown permits before they adopt the system.

Time Required for Implementation

A broadly based system of phasedown permits would probably require at least five or six years to develop and implement and might require a pilot program to assure that final implementation is successful. This estimate includes time to resolve the regulatory and policy disputes that have generally accompanied phasedown permit schemes as well as time for the market to work. For example, EPA's proposal to regulate chlorofluorocarbons (CFCs) took about four years from the point when the Agency began studying options to publishing a proposed rule. It usually requires another year to review comments and promulgate a final rule. If the Agency were to distribute permits to generators rather than TSDFs, the process would take even longer since there are no current plans to permit generators, and there would be a much larger population involved.

If Congress were to authorize EPA's development of such a system in 1988, phasedown permits could possibly be issued to TSDFs by 1994. On the other hand, if EPA chose to issue permits to generators, which are far more numerous than TSDFs, such permits might not be ready for issue until 1995. The effects of such permits on waste minimization might not be visible until 1996.

Appropriate Target Industries

EPA could target all industries and all waste streams, or apply a permit system sequentially to each set of the land ban wastes. The choice of target industries or waste streams would depend on whether unresolved problems continue with regard to the management of the wastes in question, and also whether the industry sector involved is suitable for application of a phasedown permit system. Suitability would be a function of (1) significant variation in control costs across firms, and (2) ability to set up a market that can support trades among firms. The choice to implement trading widely would facilitate the operation of the market, but would raise questions regarding trades across wastes of differing toxicities.

Costs of Development and Implementation

The costs of developing and implementing this option would depend heavily on a number of design decisions concerning the scope and structure of the program. The issues involved are as follows.

A phasedown permit system could fall short of its objective if permits became concentrated in the hands of only a few owners. These owners could create competitive barriers to entry, charge monopolistic prices, or refuse to sell permits to direct competitors. Concentration, particularly in favor of large owners, has been a characteristic criticism of other similar types of permit systems, particularly where current users are "grandfathered." EPA could address this problem by specifying a "maximum market share" to prevent concentration of permits. EPA could also try to bypass the concentration problem by picking an initial allocation scheme that does not favor the largest generators. This could be accomplished by random distribution (lottery), or stratified allocation of permits according to some criteria such as large scale generators and small scale generators, SIC code, or waste code. EPA could also prevent permit concentration by printing more permits and accordingly devalue the permits. Although devaluing the permits would remedy the concentration problem, it might also provide a disincentive for permit transactions if potential buyers believe permit values are likely to decrease.

The efficiency of the phasedown permits system could also be diminished if for some reason generators who have more permits than they need choose not to sell the extra permits on the open market. For instance, if generators perceive that each year the permits they are allowed will decrease by a certain percentage, they may want to hold on to the extra permits in order to ensure their ability to generate waste in later years. This may not be a problem, though, if permits are leased instead of sold. Also, if the transaction costs of finding buyers and sellers or negotiating the conditions of trade were very high, buyers and sellers might find that these costs outweigh any potential benefit, and choose not to participate in the market. If, on the other hand, permit holders did not use and did not sell their permits, aggregate waste production would be even less waste than if the system worked as designed. If this occurred, volume reductions would be larger than planned, but they would occur at a higher than necessary cost.

Another factor that might cause this option to fail is market uncertainty. Generators might not buy permit credits at any price if they thought these credits could shortly become worthless. For example, in 1981, Radio Corporation of America (RCA) auctioned transponder rights for satellite communications. The FCC later disallowed the sale on the grounds that the particular auction process resulted in rate discrimination. Similarly, the FAA's current rule to allow the buying and selling of landing rights at airports by initial allocation based on grandfathering may be reversed by Congress and the rights reallocated by lottery instead. As noted earlier, however, this potential uncertainty has not deterred many airlines from buying and selling slots.

Market uncertainty may also result if generators believe that EPA could decide that the system is too expensive to administer and that the Agency will pull back the permits or convert them to traditional ones. For these reasons initiation of any permit system will require a firm, long-term commitment by EPA and by implementing States, with criteria and mechanisms for any mid-source corrections which are clearly specified in advance in order to counteract the compelling effect that overhanging uncertainty can have.

In each possible example of market imperfection or outright failure, the failure is important only if it results in noncompliance with waste reduction requirements, or if it produces other serious inequities within or across industries and firms.

EPA would therefore have to address a number of issues and perform a number of analyses to implement this option. It would have to determine:

- What waste volume to permit,
- Whether or not to target reductions in such a way as to reduce toxicity,
- Who gets the permits (generators TSDFs, or both),
- What the terms would be,
- How the Agency would manage the system, and
- How to respond to market defects or trades across location and time, or whether a certain amount of permits will be reserved for new entrants.

First, the Agency needs to determine the quantity of waste or toxicity-weighted volume, and how that quantity will change over time, particularly with regard to possible industrial growth or economic contractions. A subsidiary problem is whether new generators or waste managers will be issued additional permits or whether they will have to buy permits from existing permit holders. If EPA decides to phase the permits or make them temporary rather than permanent, it can achieve waste minimization gradually by lowering the number of permits issued each cycle, or by staggering the effective date of permits issued at auction. This might also make the option more acceptable to those who do not secure permits at an initial allocation.

Second, EPA must decide who gets permits: does it make more sense to issue permits to generators or to treatment, storage, and disposal facilities? There are currently about 4,600 TSDFs, while there are approximately 15,000 generators and 170,000 newly regulated small quantity generators. It would be much easier for EPA to issue permits to TSDFs, both because there would be fewer permits to write and because those permits would be easier to enforce.

Third, once the Agency decides who receives the initial permits, it must evaluate the different allocation schemes in terms of implementation costs, equity, and administration. (If EPA is to sell the permits, it needs to determine the appropriate market price.) To do this, the Agency needs to determine how much it will cost generators to reduce the quantity of waste they generate. With this information, it is possible to estimate who will buy and who will sell permits in the marketplace, and what the market clearing price will be. The necessary data include the number of current generators, their respective volumes of particular hazardous wastes, their current management costs, and recycling and source reduction costs per metric ton. Extensive data gathering and analysis will be necessary to develop this information. If permits are allocated by grandfathering, the Agency needs to decide whether to charge a fee for the permits. In both cases, EPA needs to consider what to do with the revenue generated. The fees could help defray the significant administrative and enforcement costs associated with this option.

Fourth, EPA needs to determine the optimal term for waste generation permits. This would probably depend on how long it would take generators to recover the costs of their investment in waste reduction technology, the relative impacts on State and local areas and on total waste reduction, and whether use of credits would be confined to given geographic areas or stratified by industry or waste stream. Permits could be marketable nationally or they could be confined to a State or a region. If permits are marketable nationally, EPA must decide how to handle trades across locations (e.g., moving waste generation or management from a low risk area to a high risk area in terms of fate, transport, and exposure). EPA must also decide how to handle a potential futures market for waste permits.

Fifth, EPA must determine how to manage and enforce the phasedown permits system. The more directly involved EPA gets, the higher the costs for implementation and enforcement.

Sixth, EPA must determine if there are any market defects which may not allow the phasedown permit system to work well. For example, concentration of ownership could be a problem, as well as "market thinness", which means the market has very few buyers and sellers because of the high costs of transactions. In order to encourage market effectiveness, the Agency needs to consider whether it is appropriate to use a stratified scheme, in which the market is segmented into two or more classes. Stratification may also help if the Agency wants to selectively encourage waste reduction for the more toxic waste streams. Stratification by industry group would help to avoid market concentration and monopoly power for a few large waste generators. Consideration of other agencies' experience with phasedown permits should provide both options and a range of potential answers to these and related concerns.

Given the complexities of the issues discussed above, the costs to implement this option are likely to be high. If EPA decides to act as an information broker there would be substantial costs to put buyers and sellers in touch with each other. If the Agency decides to act as certifier and enforcer, it would need a mechanism to keep track of permit transactions. If EPA decides to act as gatekeeper, implementation costs would be even higher, since this would require an administrative procedure to act on applications from buyers and sellers, and also may incur the costs of litigation. This would also impose time constraints and thus limit the number of transactions.

If the Agency decided to use a stratified approach (e.g., two classes of permits for different toxicity classes of wastes), administrative costs would be higher than if there were only one market to keep track of. The term of the permit would also affect implementation costs. However, while a shorter term would mean more administrative cycles for EPA, this would provide for more control over how fast waste reduction occurred.

Enforcement costs for this option would depend on whether EPA issued permits to generators or to TSDFs. It would be more difficult and more expensive to ensure that generators are not producing more waste than they are allowed, since EPA exercises less oversight over generators than over management facilities. In order to enforce this option, EPA would need to keep track of changes in the initial allocation of permits. This would be possible if the Agency acts as a certifier and enforcer. All transactions would then have to be filed with EPA.

Other Issues

Public Reaction: A drawback of this option is the common perception that it allows the rich to pollute. In fact, a phasedown permits system would generally reward generators who have low recycling and source reduction costs, regardless of whether they are rich or poor.

Whether the public and industry ultimately accept this option may depend on the allocation scheme adopted. Since all versions of this option cause significant transfers of wealth, the general public may not like the government or certain large generators benefitting at the expense of small generators, if small generators are less likely to be able to reduce waste volumes economically and therefore need to purchase more permits. In addition, there are likely to be diverse interests among state governments, environmentalists, and industry associations. EPA would have to consider whether State governments can become involved as subsidiary regulators controlling the buying and selling of permits. The Agency would also have to undertake substantial public information efforts to communicate the program's goals and benefits.

It is interesting that the cost to society for controlling any specific set of wastes is the same for all variations of the phasedown permits option. Whether EPA auctions the permits or generators buy and sell the permits after a lottery or grandfathering allocation, the price of a permit should eventually reach a market equilibrium. However, while the cost to society is the same for the various phasedown permit options, the transfer payments differ significantly.

3.0 Recommendations

Data are not yet available to make a specific recommendation on the desirability and feasibility of instituting a phasedown permit system for hazardous waste minimization. If specific problems are still found to exist with regard to individual waste streams or industrial sectors after full implementation of the land disposal restrictions program and other key provisions of HSWA, then mandatory waste reduction measures may be appropriate. A phasedown permit system would be desirable and feasible in this situation under the following conditions:

1. For the industrial sector or waste streams in question, the costs of control per unit reduction in waste generation vary significantly among potential participating firms. (If costs do not vary among firms, there would be no benefits to trades except to arrive at a distribution of permits proportional to previous generation rates.)
2. EPA determines that the location at which waste might be generated, treated, or disposed of would not affect human health or environmental impacts.
3. EPA determines that it would be less expensive to implement this system than to implement an equivalently effective conventional performance standard.

Under this option, EPA should consider exempting small quantity generators from the requirements or should consider subjecting them to simplified and less burdensome requirements. Because small quantity generators collectively account for only a small fraction of the waste generated annually, subjecting them to stringent and expensive regulations would probably not be cost-effective.

Requirements for Certification of Waste Minimization

1.0 General Summary

The Hazardous and Solid Waste Amendments (HSWA) of 1984 impose new requirements on generators of hazardous wastes for waste minimization.

First, generators must certify that they are making efforts, to the extent economically practicable, to minimize wastes—a certification based entirely on the generator's judgment. The certification of waste minimization is required on hazardous waste manifests and on the operating log of any RCRA-permitted TSD facility operated on the premises of a generator. Second, generators must submit information on their biennial reports about the nature and scope of their efforts. The intent of these requirements is to provide the generators with an incentive to think more closely about the desirability and opportunity to minimize wastes and to keep EPA and the States abreast of waste minimization efforts occurring throughout the country.

The specific requirement for generators to certify efforts to minimize wastes applies in two circumstances:

- Generators shipping wastes offsite must sign a waste minimization certification on the hazardous waste manifest.
- Permitted TSD facilities on the premises of a generator must provide a certification of waste minimization efforts being made by the generator. This certification is retained as part of the operating log of the facility.

The actual requirement in HSWA is the same in both cases. The generator or permittee must certify that:

- "The generator of the hazardous waste has a program in place to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable; and
- "The proposed method of treatment, storage, or disposal is that practicable method currently available to the generator which

> minimizes the present and future threat to human health and the environment."

The Senate Report on certification stresses at several points that the requirement is strictly one of certification by the generator:

> "While these provisions encourage the reduction of hazardous waste generated, they are directed at the generators of such waste and do not authorize the Environmental Protection Agency or any other person or organization to interfere with or intrude into the production process or production decision of individual generators... The nature of the criteria for the certification and the determination of compliance with those criteria are made solely by the generator."

Only the generator, therefore, may determine what constitutes appropriate action for reducing the volume or quantity and toxicity of waste, or what is economically practicable. Similarly, only the generator may determine what constitutes, for the generator, the available practicable method of treatment, storage, or disposal which will minimize the future threat to human health and the environment. EPA therefore interprets the certification requirements as prohibiting the development of any formal guidance to generators on what constitutes appropriate waste minimization. As the Senate Report on the certification process emphasizes, the intent of the current requirement is merely to encourage generators to consider specifically the desirability and feasibility of waste minimization; it does not require specific waste minimization action.

The Agency believes that in most cases generators should continue to determine what their waste minimization options are, and, at this time, that EPA should not make specific process related decisions to force waste minimization. EPA will, however, be developing general guidance on approaches to waste minimization which it believes to be beneficial or desirable, and is currently engaged in research on waste audit techniques to better identify opportunities for waste minimization. EPA has responded to letters of inquiry on these issues by specifically endorsing certain general activities as sound waste minimization practices. For example, the Agency has stated that sending hazardous wastes to solvent recycling facilities for reclamation and reuse meets the intent of the waste minimization certification. It has also encouraged transferring hazardous wastes through waste exchanges to companies which can reclaim or reuse them, when such wastes would otherwise be disposed of.

The option under consideration here is to allow EPA to provide more specific guidance on waste minimization practices in specific circumstances. The authority would be used selectively in limited circumstances where the Agency has reason to believe that self certified programs are not protective of human health and the environment. Economic practicability assessments would remain under the purview of the generator, but EPA would seek discretionary authority to require that a generator submit a written explanation why he or she believes that an available and commonly used waste minimization practice is not economically practicable in a specific case. This authority could be used as a mechanism to ensure the exchange of pertinent technical and economic information. (While small quantity generators might be subject to somewhat increased reporting responsibilities under this option, EPA could consider subjecting them to less rigorous and burdensome requirements than those affecting large quantity generators.)

There is a range of ways in which EPA's role with respect to such certifications could be modified. The possible combinations of authority would be:

- EPA could develop guidance characterizing certain practices to be unacceptable as waste minimization (e.g., dewatering), and effectively prohibit their use as a basis for certification. While this would prohibit certification based on that activity, it would, by itself, have no mandatory effect on industry with respect to other aspects of the certification.

  — If EPA were also given authority to determine economic practicability, it would have no additional impact unless EPA also had the authority to develop guidance on what is waste minimization.

- EPA could develop broad classes of waste minimization practices, as well as industry-specific guidance as to what constitutes waste minimization for a particular industrial sector. Depending on the requirements for its industrial sector, a generator would be required to meet one or more of these specifications in order to certify that it has a waste minimization program in place. In lieu of this, the generator could offer an explanation of an alternative practice which the generator believes meets waste minimization objectives.

— If EPA also had the authority to evaluate the generator's certification that none of the specified practices were economically practicable, it would in effect be empowered to impose performance standards through the certification process.

— If the assessment of economic practicability continued to be based strictly on the selfcertification of the generator, the generator would still be free to certify that it had met the requirement because it was not economically practicable to undertake any of the waste minimization practices.

Since EPA's authority would be discretionary, these requirements could be applied selectively in cases where analysis of baseline and trends data on waste generation, recycling, and management indicate that particular industrial sectors are still creating residual problems and health risks because of the volume and/or toxicity of the wastes generated, and the waste minimization or management practices used.

Examples of circumstances where the availability of this discretionary authority would substantially enhance the effectiveness of waste minimization efforts include:

1. Where generators' self-certified waste minimization programs are in fact ineffective: Certain practices that generators may certify as waste minimization may in fact produce no net reduction in waste volume or toxicity. For instance, some companies list membership in a waste exchange as a waste minimization program, even though they have never made a transaction in that exchange. Discretionary authority to define waste minimization practices specifically would help force all generators to adopt good-faith programs.

2. Where generators' waste minimization activities present adverse environmental risks: In a limited number of cases, generators waste minimization efforts might actually be increasing human health and environmental risks rather than decreasing them. An example might be the use of air stripping to remove volatile organic compounds from waste streams, thereby creating an air pollution problem. By specifically describing technologies, practices, and situations that must *not* be considered valid waste minimization approaches, the Agency would discourage such activities.

3. Where valid waste minimization practices have not been adopted for reasons of economic practicability: Where, despite clear guidance on what constitutes a constructive waste minimization program, generators take no action on grounds of economic impracticability, this discretionary authority would give EPA better insight into the

> economic forces involved. This data would be valuable in reviewing the practicability all other waste minimization options, from mandatory performance standards to technical assistance programs.

The current legislation would have to be amended to allow EPA to define these acceptable waste minimization practices, as well as practices that could *not* be certified as waste minimization in certain circumstances (e.g., those practices, such as noted above, that result in adverse cross-media pollution transfers). As additional information becomes available, the Agency could use this discretionary authority to focus on specific industries that continue to create potential risks to human health and the environment. The Agency emphasizes that this authority would be used sparingly, not as a method of enacting *de facto* performance standards on a large scale.

2.0 Evaluation

2.1 Technical Effectiveness

Volume and Toxicity Reduction

It is impossible to predict the effect of modifications of the certification process on the volume, quantity, or toxicity of wastes that could be associated with the changes to the certification program described above, though the overall effect would certainly be positive. Clearly, the important aspect of this program would be that it would operate as part of a more comprehensive waste minimization strategy. As such it would allow EPA to provide specific guidance to firms that need it (and often ask for it); it would also allow EPA to curtail use of approaches that might be counterproductive in protecting human health and the environment.

2.2 Impacts on Industry

Economic Impacts

For those facilities required to meet the stricter certification requirements, the costs would depend on whether they were currently practicing waste minimization alternatives or have a waste minimization program determined to be certifiable. If so, the certification requirement would be identical to that under existing law and regulations, and would involve no new costs. If not, the facility would have the additional cost either of describing an alternative waste minimization activity or of writing a justification for certifying that none of the specified waste minimization alternatives were economically practicable.

Equity

There are two equity issues of importance. The first is whether appropriate industries are selected for application of the new certification procedure. The second is whether the requirement for demonstrating economic impracticability is unduly burdensome. These issues would have to be properly addressed when guidance is developed.

Incentives for Non-compliance

Non-compliance could be an issue if a firm knowingly adopted a waste minimization practice that EPA had specifically listed as undesirable. Since the authority would be used selectively and in relation to known problem areas, discovery of this type of non-compliance would presumably not be difficult.

2.3 Implementation Issues

Legislative Authority

EPA would need to acquire express legislative authority to undertake any of these alternatives, since the current statutory requirements are clearly intended to be directed at generators. EPA could be given the authority to characterize certain practices as waste minimization, to prohibit the characterization of specific practices as waste minimization, or to determine economic practicability.

Time Required for Implementation

Since amendments to RCRA would be required to provide EPA with the authority necessary to specify certifiable waste minimization activities, the earliest date at which EPA could have the legal authority to implement this option would be 1988. A decision to use such discretionary authority would be based on a careful review of data on trends in waste generation and management, taking into account the impacts of successive phases of the land disposal restrictions. With the possibility of two year variances, data incorporating the impacts of the first phase of the land disposal restrictions would probably not be available until 1989. Specifications of particular activities as constituting or not constituting waste minimization would require a rulemaking, necessitating at minimum an additional six months. Subsequent implementation would depend on development of data as other phases of the land disposal restrictions take effect. With variances, the last of these would be in 1992.

Appropriate Target Industries

The most appropriate industrial sectors to review for possible application of the guidance procedures outlined above would be those most affected by each successive phase of the land disposal restrictions. Such a procedure would only be used in cases where the available data indicate that opportunities for waste minimization are not being utilized and there remained a significant risk to human health and the environment. It is not possible to predict at present which industrial sectors would be most likely to require such additional pressure. They are most likely to be among those for which reductions in waste generation would be extremely costly.

Costs of Development and Implementation

There would be some limited costs involved in the development of guidance for the selected industrial sectors, but much of this would be developed from already existing information and based on ongoing data evaluations. Required rulemaking could be both time consuming and costly, however, the overall costs would depend on how extensively EPA made use of this authority.

Enforcement costs, like implementation costs, would depend primarily on how often the Agency made use of its discretionary authority. Enforcement resources required for reviewing either the alternative waste minimization strategy filings or the economic justification filings could be substantial. Enforceability would depend on use of penalties applicable to generators who fail to fulfill permit or hazardous waste manifest requirements.

3.0 Recommendations

EPA recommends that certification by the generator should continue in order to assure that waste minimization programs remain economically practicable; the certification of waste minimization programs by generators on manifests and on the operating logs of TSD facilities should also continue.

Nevertheless, as data on trends in waste generation and management become available some problem areas may become apparent where the availability of additional discretionary authority would be a valuable tool to enhance waste minimization. Under circumstances where the generator has not undertaken any waste minimization activities, which could be determined through the biennial reporting requirement, the Administrator could be provided discretionary authority to require the generator to submit to the Administrator a justification as to why none of the waste minimization alternatives are economically practicable.[12] The generator's rationale would not be challengeable, but nonproprietary information would be publicly available.

The intent of the additional legislative authority would be for EPA to be able to promulgate a limited number of programs. For instance:

- After careful consideration of all the implications for cross-media environmental effects, EPA might specify one or more practices that could not acceptably be certified as waste minimization.
- Once data are available to develop meaningful information on what changes and trends are occurring, EPA might increase the specificity of its guidance, and define more precisely for certain environmentally critical industries which practices constitute waste minimization. Generators would remain free to specify other practices as meeting the waste minimization requirement, and to submit a description of those practices. Unless EPA were to choose

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[12] An alternative format of the certification would have to be written to allow for a two part certification separately covering waste minimization activities and economic practicability.

> to place such a practice on the list of unacceptable practices for certification, it would have to accept the generator's certification.

EPA would use its new discretionary authority *only in cases* where data developed through biennial reports, the CAIR questionnaire, or other data sources indicated that current waste generation and management or specified waste minimization practices result in potential risks to human health or the environment. The effect would be to force industry to think more carefully about the opportunities open to it to minimize waste. If, after these steps, the Agency still finds that unreasonable risks to human health or the environment remain, it would use authority under TSCA Section 6(a) or 6(b) to impose additional requirements either generally on the handling of particular waste streams by an industrial sector, or specifically on the activities of a particular generator.

At this time EPA is not able to recommend the implementation of this option. however, as part of the next RCRA reauthorization, EPA will provide Congress its most current assessment of the need to modify the existing waste minimization requirements.

Ban the Landfilling, Treatment, or Incineration of Potentially Recyclable Wastes

1.0 General Summary

The Agency could encourage waste minimization by imposing an option which would ban land disposal, treatment or incineration of wastes that it considers to be recyclable. This management practice option would force generators of selected wastes to decide whether to recycle waste streams, find source reduction measures, or stop producing the products that generate the potentially recyclable wastes altogether.

The types of wastes most appropriate for this option would be those that have already been shown to be recyclable or could become recyclable with further research and technological development. Obviously, wastes that are not yet known to be recycled or are only in the research and development stage are not expected to be recycled by industry. It is less obvious, however, why a waste that is known to be recyclable is not recycled.

Recycling may be more expensive than conventional methods of treating, landfilling or incinerating wastes. Other reasons include lack of information on recycling potential, a latent or undeveloped market for a recycled waste, an inability for a firm to meet the same purity standards that apply for virgin materials, and lack of financial capability of a facility to make the necessary changes in the production process to prepare a waste for recycling.

The rationale for Agency intervention using this option would be to help stimulate industry's behavior toward recycling. The option would not only encourage reuse of wastes but it would reduce the volume of wastes that are being disposed of through conventional means, thus, freeing up room in landfills for wastes that cannot be recycled. In conjunction with other options that have been evaluated in this report (e.g., technical assistance, procurement practices), banning recyclable wastes would help speed industry's effort to recycle wastes.

Unlike a complete prohibition or restriction in the generation of waste, this option's primary attention is on wastes at the end–of–pipe. This option is only concerned with feedstocks to the extent that the recycled waste can be recycled as an input in other production processes. In some cases the waste can be recycled back into the same process as a feedstock from whence it had been generated (e.g., dry cleaning solvents).

In developing this option, it is necessary to address a number of other issues. First, the Agency needs to define "recyclable" and identify recyclable waste streams. Since almost any waste stream could be recycled, albeit at a high cost, it appears that it will be necessary to consider cost in the definition of wastes potentially recyclable. However, there is no obvious correct level of costs below which wastes are recyclable and above which they are not. If the cost is set too high, firms may stop producing the waste generating product altogether. After defining the term, the Agency needs to decide how often it will revise its list of recyclable wastes as technological advances provide increased opportunities for reducing the cost of recycling.

A very limited example of this option exists in California. To make the ban manageable, California only prohibits land disposal of recyclable wastes, but it allows generators to treat or incinerate the recyclable wastes. Furthermore, the list of wastes banned from land disposal includes only some, not all, recyclable wastes.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

This option has the potential to induce significant reductions in the volume of waste that would ordinarily be sent to landfills, treatment or incineration. The actual volume reduction will depend on the number and volume of the waste streams classified as recyclable. The impact on volume reduction will also be dependent on how the recycled waste will be used. The impact on volume may be greater if the waste can be recycled several times before it is must be disposed (e.g., dry cleaning solvents or recovery of acids from spent pickle liquor in the primary metals industry). However, preparing a waste for recycling may generate a waste (impurities that are removed from the recycled waste) which will have to be disposed. In other cases a waste may only be recycled once as a feedstock in another process (e.g., recycling of pesticide dusts at pesticide fomulating facilities). These processes will, in turn, generate a volume of waste that must also be disposed.

Toxicity Reduction

The impact on toxicity that this option will have depends on the type of waste that is recycled. Some wastes that are prepared for recycling may require removing impurities. The residual waste may be more concentrated and more toxic than the waste being recycled. If the recyclable waste does not have a residual waste then there should be no impact on toxicity of the remaining wastes.

Other Technical Effectiveness Issues

Two factors could limit the effectiveness of this option: (1) lack of demand for recycled wastes, and (2) the use of a variance program. Insufficient demand for the recycled products creates potential problems with the program's effectiveness. Waste generators are currently recycling only to the extent that demand exists to justify the cost of recycling. This option may have to be coupled with other EPA measures (e.g., expanded use of a waste exchange system) to increase the demand for the wastes that may be recycled.

A variance or appeals program could also reduce the effectiveness of this option. California currently has in place a limited form of this option. Some variances are granted. To obtain a variance, generators are supposed to show that recycling, treating or incinerating the recyclable waste will be either technically or economically infeasible. If such a method is allowed under this option, it could be very cumbersome since appeals would slow the process of implementation.

2.2 Impacts on Industry

Economic Impacts

Bans may be an expensive means of obtaining volume reductions compared to other proposed options such as phasedown permits. Unlike these other options, the mechanism for banning the generation of certain waste streams is not a function of a market.

Therefore, a ban is indifferent to the costs that would be involved in the actual processes that would be required of a facility to meet the option.

Total cost to industry would depend on how much of a potentially recyclable waste is selected to be recycled. It could be very expensive if the option is applied to all of the waste rather than to a portion of the waste. Other factors that need to be evaluated in order to estimate the costs to industry are:

- The costs of retrofitting a facility with the machinery to prepare the designated waste for recycling.
- The costs for developing a market for the recycled wastes. There may be very little demand in the early stages of recycling the waste. Facilities may have to absorb the costs of recycling in order to generate demand for their wastes.

Equity

Waste generators may view the option as inequitable since only selected waste streams and generators will participate in the option.

Incentives for Noncompliance

There is the possibility that imposing a ban on recyclable wastes could create incentives for noncompliance. If the imposition of this option is more costly than the current way a facility disposes waste it might deliberately continue to treat its wastes rather than comply with the recycling regulations. The degree that a facility might choose to not comply, however, will be dependent on the enforceability of this option.

2.3 Implementation issues

Legislative Authority

It does not appear that there is authority under RCRA to enact such a ban with the exception of the portion relating to landfilling. An examination of Section 6 (a)(6)(A) of the Toxic Substances Control Act (TSCA) indicates that any disposal method can be prohibited or regulated. Such an action may be taken only if the Administrator finds that the disposal of a chemical substance or mixture presents an "unreasonable risk of injury to human health or the environment,"(Section 6 (a)). Thus, to enact this option, EPA would need to evaluate recyclable substances for their risk to human health and the environment when landfilled, incinerated, or treated. The likelihood, however, of a waste posing an "unreasonable risk" when landfilled, treated, or incinerated but not when recycled seems low. Thus, TSCA does not seem to be a vehicle for implementation of this option.

Time Required for Implementation

It will take about eight years to implement this option; four years to determine whether this option is necessary; three years to propose regulations; and another year to promulgate them. In comparison, it took EPA a few more years to promulgate its redefinition of solid waste, an issue only slightly more complex. It is likely that the period during which regulations are proposed would be quite controversial and time consuming. One of the major factors in this process will be EPA's determination of the degree that economics will play in the definition of what wastes are recyclable.

Appropriate Target Industries

This option will be most appropriate for industries generating highly toxic waste streams whose wastes have a potential for recycling or source reduction and for which recycling technologies are available. Without careful analysis prohibiting waste generation could have a deleterious effect on improperly selected industries. It is conceivable that a ban could exceed a facility's capability of changing its production processes. In these cases firms would be forced to stop production.

Costs of Development and Implementation

There is insufficient information to make clear cost estimates on the implementation of this option. First, perhaps the most costly aspect of implementing this option is enforcement. "Honor systems" will be least apt to work under conditions where recycling may be more expensive than conventional treatment of wastes; in such cases the Agency would have to be particularly vigilant in monitoring recycling practices. To enforce these regulations the Agency would have to discover failure to recycle before wastes are sent offsite, since it will be difficult, if not impossible, to identify violations after treatment, disposal, or incineration.

Second, the staffing requirements of the option may be large. This would be particularly true for enforcement. For other administration, staffing size and cost would depend in part on whether Regional Offices or Headquarters will be responsible for implementing the regulations.

Third, EPA needs to aid in the promotion and development of additional, recycled wastes, uses and markets for recycled wastes. There would presumably be some costs involved for research and development on recylcling technologies, and continued support of waste exchange programs would be necessary to assure continued access by regulated generators to markets for recycled materials.

Finally, the Agency might study the experience of California for other costs that would be involved with a ban on disposal, treatment and incineration of wastes. Their experience can help to define the outline and logistical structure for implementation. For instance, it would be important to study whether the ban works best under a two-stage whereby California strictly enforces compliance for a limited number of streams, yet encourages recycling by industry for a much larger number of wastes than are regulated.[13]

3.0 Recommendations

Banning land disposal, treatment, or incineration of potentially recyclable waste streams appears to be an expensive method of achieving reductions in the quantity of hazardous waste generated and the risk/toxicity of wastes. It is probably premature to consider this option prior to determining the effect that land disposal restrictions and the issuance of Part 264 permits will have on the quantity of waste generated. This option should probably be the last resort for inducing waste minimization. It would be appropriate only when the following conditions are met:

- The waste streams under consideration are extremely toxic,

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[13] In California, generators must explain why they did not recycle or treat recyclable wastes. The State cannot force generators to recycle unless the wastes exceed certain concentrations

- EPA is convinced that current management practices cannot overcome unacceptable levels of risk from waste generated in their facility, and
- When other waste minimization measures have failed.

Segregation of Wastes

1.0 General Summary

Many waste streams are in reality a mixture of two or more component wastes generated at different points in a production process, but combined to reduce handling requirements, save transportation costs, or achieve scale economies in treatment or disposal. This management practice would ban the mixing of waste streams where one or more of the components is identified as recyclable. While the option would not *require* a segregated waste to be recycled (this could only be done through banning the waste's treatment or disposal), it is assumed that once having segregated recyclable wastes, a generator would have a strong incentive to initiate recycling.

This option could be implemented at varying levels of stringency. At one extreme, segregation could be required on a self-enforcing basis to the extent determined to be practical or economically feasible by the generator. At the other extreme, it could be mandated through detailed and enforceable regulations, such as in conjunction with a general waste minimization performance standard (see "Performance Standards").

Recycling covers both reuse and reclamation activities; the recycling method most appropriate would depend on the type of waste that is segregated. In some cases the waste could be used for energy recovery (as is often possible, for instance, with solvents). In other instances the waste might be appropriate as a feedstock in the production of another product (for example, ferric chloride waste from titanium dioxide manufacturing can be used as a feedstock in water treatment), or reused in the same production process (for example, acids from spent pickle liquor in the primary metals industry can often be recovered).

Internal or onsite recycling potential would have to be determined through industry-specific analyses. Information on what materials could be recycled offsite could be developed through industry analyses as well as through data obtained through waste exchanges. While such a regulatory requirement might not specifically require recycling of the streams once they are segregated, it would make recycling more feasible by producing waste streams that are relatively uncontaminated (by virtue of not being a random mixture) and thus more amenable to subsequent recovery. In addition, the remaining waste streams might be easier and safer to treat and dispose of than combined waste streams.

EPA could decide when waste stream segregation would be required based on the same types of technology evaluations and economic analyses that are currently used to make the technology-based performance standard determinations under the Clean Air and Clean Water Acts. Management practices could include:

- Isolation of hazardous materials from nonhazardous materials,
- Isolation of recyclable materials from nonhazardous materials,
- Isolation of hazardous waste by contaminant, and
- Isolation of liquid from solid waste.

In certain cases, cost savings may be the greatest nonregulatory incentive for segregation. Segregation can be economically attractive to a facility by potentially (a) reducing treatment and disposal costs, (b) lowering expenses for the purchase of raw materials, and/or (c) producing a desirable product that can be marketed or sent to a waste exchange. In fact, requiring segregation of wastes could facilitate waste exchange efforts by expanding the market for the purchase and sale of recyclable wastes. It should be noted, however, that even after a segregated waste has been determined to be "potentially recyclable," recycling is still dependent on market, geographic, and technical factors, which can vary substantially. In some cases, generators complying with a segregation requirement may not be able to recycle and may be forced to continue to send their wastes to treatment or land disposal.

This option is clearly not applicable to all waste streams, and, in fact, might be applied only in limited situations. Merging streams is usually done both for convenience and to save costs. Streams have sometimes been combined to reduce piping requirements or minimize treatment expenditures through the construction and operation of single large treatment facilities, rather than through distributed smaller units. Consequently, little or no cost savings would be realized in some situations.

Data needs for establishing a waste segregation requirement would be considerable. First, technical information would be needed on which industries and processes can potentially segregate their wastes. Monitoring data would be needed for selected waste streams to adequately characterize the streams to assess their recycling potential. Information would be needed on the costs of process and treatment modifications and the economics of the affected industries. Finally, a survey might have to be undertaken to identify markets for recycling the segregated wastes.

2.0 Detailed Evaluation

Volume Reduction

This option has the potential to significantly reduce the volume of some wastes otherwise treated or disposed of on land. Based on data developed for the RCRA Risk/Cost Analysis Model, it appears that segregation of streams can be effective in reducing waste volumes for such industries and processes as acrylonitrile manufacturing, petroleum refining, phenolic resins manufacturing, and metal treating.

Toxicity Reduction

It is also apparent, based on limited data in the RCRA Risk/Cost Analysis Model,[14] that some relatively high volume streams that have been identified as potentially segregatable are also quite toxic. Notable among these are solvent laden wastes generated during the cleaning of equipment and metal surfaces, pesticide dusts collected in baghouses at formulators, and an assortment of wastes containing levels of highly toxic organic compounds and metals. If such highly toxic wastes were segregated from existing composite waste streams, it is possible that the remainder of the waste stream (which would be sent to treatment or some form of land disposal) would be less toxic. Segregating wastes may therefore indirectly accomplish some reduction in waste stream toxicity.

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[14] *The RCRA Risk-Cost Analysis Model: Phase III Report — Appendix A.* USEPA, Office of Solid Waste, Washington, D.C., 1984.

2.2 Impacts on Industry

Economic Impacts

Without detailed identification of potential targets, and considerable information on compliance costs, it is impossible to estimate how much the development of technology based standards for segregating wastes would cost industry. If other technology-based performance standards were implemented simultaneously, then the marginal cost of complying with segregation requirements would presumably be relatively minor.

Segregation does have the potential in selected instances to be economically attractive, and can in some cases save an industry or a facility significant sums of money. Actual costs, however, will vary based on the type of process, the size and composition of the waste stream, the market for and value of the recycled waste, the age and physical constraints of the plants, and geographic location. In addition, new prohibitions on land disposal and dramatically increased costs for all forms of disposal, coupled with substantial efforts to increase industry awareness of recycling possibilities, may provide adequate information and incentive for waste stream segregation without requiring such action by regulation. Estimating the actual cost impacts is complicated by fluctuations in the demand for (and cost of) the segregated, recyclable material.

The cost of waste segregation may, however, fall disproportionately on the consumer. This is so if some industrial sectors can avoid the costs of segregating wastes by passing on these costs to the consumer. The trade off in the consumer's absorption of the costs of segregation would be if there is a real benefit through a reduction in human health and environmental risks. However, the benefit of reduction in the human health and environmental risk would presumably be shared equally among both the producer and consumer.

Equity

Because of the nature of the wastes to be segregated for recycling, the option could fall disproportionately on selected industries. Since there is, however, the possibility that the regulated industries may realize a profit from the generation of wastes, the regulations for those industries may not actually be much of a burden.

Incentives for Noncompliance

Compliance may not be a problem if segregation of wastes results in an economic return. However, if compliance with the option is more costly than the way a facility normally treats waste, it might deliberately continue to treat its wastes in a conventional manner. The degree that a facility might choose to not comply, however, will be dependent on the enforcement of this option.

2.3 Implementation Issues

Legislative Authority

It is not clear what the legislative authority is for requiring segregation of wastes. Section 3002 of RCRA states that EPA shall establish standards for generators "as may be necessary to protect human health and the environment," but does not specifically list waste segregation as a requirement. If this option is not currently mandated by RCRA, the Act may have to be amended. Another possible approach would be through the use of TSCA Section 6.

Appropriate Target Industries

In order to identify the target industries, a survey must be undertaken to identify those industries where segregation of wastes can, in fact, achieve significant reductions in wastes. The survey and the subsequent industry-specific analyses will be both resource intensive and time consuming. Some preliminary studies have been performed to evaluate the potential impact that waste segregation can have on minimization for specific industries. There are a number of industries and processes where the potential for recycling would be substantial if the appropriate wastes were segregated. The following are a few examples:

- The agricultural chemical formulation and paint manufacturing industries could both reduce their waste volumes by using air pollution controls (baghouses) dedicated to collecting a single type of dust, i.e., pesticide or pigment. This would eliminate the contamination of one waste stream with a second waste, thus expediting recycling or reuse of the recovered materials.

- By segregating aqueous and oily wastes, the petroleum refining industry could bypass the API Separator, thereby reducing its load and allowing for better separation efficiency for existing separators. This could be accomplished by installing a separate sewer system to convey oil free aqueous wastes.
- During the treatment of metal surfaces prior to electroplating, plating, anodizing, coloring, and finishing, rinse waters and spent baths were often mixed and treated jointly. Recycling and reuse can be promoted by segregating various rinses.
- The wood preserving industry can apply "good operating practices" to segregate waste streams by isolating (a) hazardous materials from nonhazardous materials, (b) hazardous waste by contaminant, and (c) liquid waste from solid waste.

Costs of Implementation

The cost of implementation is not yet quantifiable, but it would be likely to include the development and operation of a permit program, and would include resources expended at both the Federal and State levels. Incremental costs would presumably be modest if waste segregation were implemented in conjunction with performance standards. Implementation costs, however, would likely be significant if segregation were required in the absence of performance standards.

As noted earlier, the development of a regulation of this type could be as simple as requiring that facilities segregate their wastes to the extent that is feasible and practicable, or could be as technically complex as the establishment of technology based standards. Technology based standards would require extensive surveys of industry (to identify which operations and processes offer potential for segregation), site visits, monitoring of waste streams, surveys of potential facilities, and identification of markets for recycling of the streams.

If enacted on a mandatory basis, a waste segregation requirement could impose significant additional costs on the States. It is likely that considerable effort will be needed to review permit applications, including design and operating modifications, and to conduct onsite enforcement inspections. Federal assistance may be needed if these best management practice requirements are to be managed on a State level. If performance standards were enacted to minimize wastes, then enforcement of segregation requirements could be included at minimal additional cost to the States.

Enforcement cost would involve visiting the sites to check piping, tanks, drums, and general waste handling practices. Except for segregation of wastes involving waste handling practices by personnel, enforcement would primarily require verifying that the pipes and the plant waste stream diagrams showing waste stream segregation corresponded with each other. The site visit at an average plant could require one person-day for enforcement personnel.

Assuming that enforcement inspections would be carried out annually for 10 percent of all generators other than small quantity generators (or 4,300 generators annually), approximately 24 additional enforcement man-years would be required. With support staff, salary, and other costs, this would entail additional annual costs of about $2.1 million.

3.0 Recommendations

Several conditions should be met before this option is implemented for any particular waste stream. First, only wastes that have realistic economic and technical potential to be recycled on the scale at which they are produced should be segregated; segregation would clearly not be desirable if the amount segregated substantially exceeded the size of the recycling market. The selection of an inappropriate waste stream—a stream with no economical recyclability, or a stream produced in far larger volume than the capacity of the recycling market—would present unnecessary costs to industry, and would achieve no beneficial effect (since the waste would have to be treated and disposed of as before). Second, a market for the recycled waste should be in operation or nearing operation, so that facilities could quickly begin to recycle their segregated wastes. Third, there would have to be a continued effort by the Agency to encourage recycling by promoting waste exchanges and by disseminating information to facilities on technologies for segregation. Finally, this management practice would probably work best in conjunction with some type of performance standard, such as the option to prohibit conventional treatment of a waste that is designated as recyclable, or in conjunction with a major performance standard program.

Mandatory Waste Audits

1.0 General Summary

A waste audit is defined as the formal study of waste generation within a specific facility and identification of possibilities for reduction and/or recycling of wastes. Its purpose is to identify the waste streams, the quantity of waste generated, and the production processes that are responsible for generating each particular stream. Many firms already conduct waste audits voluntarily; the option under consideration here is whether or not to make waste audits mandatory, and if so, to what extent and in regard to which categories of generators.

Information from an audit could be handled under two slightly different alternatives: it could be retained by the firm for internal use, or it could be shared with EPA. The two alternatives imply different assumptions about how audits would influence waste minimization. The first assumes that the audit itself would provide sufficient incentive for the firm to take corrective action. The second alternative would allow EPA to determine whether a firm was doing everthing possible to minimize waste. In the latter instance, the use of audit information by EPA raises serious questions regarding access to proprietary information, as well as significant increases in Agency management costs.

Currently, several State technical assistance programs provide some waste audit services. These may be carried out either by State personnel or through arrangements with private sector consultants. Minnesota's MnTAP program, for example, places engineering interns in plants for an entire summer to carry out such audits in cooperation with engineers at the facility. The State programs, however, are strictly voluntary. Firms are not required to undertake waste audits, nor are they required to adopt the recommendations of audits they agree to conduct.

A number of factors should be addressed by any waste audit, including:[15]

- Identification of waste streams and flow rates in the facility being audited;
- Delineation of waste generation problems;
- Postulation of a range of solutions for each of these problems;
- Screening to determine which of these potential solutions should be studied more thoroughly (using criteria based on feasibility, effectiveness, cost, current application experience within a waste generating sector);
- Documentation of these options, and presentation to and discussion with plant personnel; and
- Final rankings of most reasonable options in light of evaluation and discussions.

Following the final ranking, it would be necessary to examine the feasibility of implementing the recommended waste reduction option or options. This step would go beyond what is generally considered to be part of the waste audit and involve an actual engineering or feasibility study.

It is usually considered preferable to have waste audits conducted by engineers who are not directly associated with a plant's operations or employees of the audited company. This avoids conflict of interest problems and reduces the possibility that the auditor is committed to the standard operating procedures within the facility. In a large company it might be possible to meet this criterion of neutrality while having such studies carried out by uninvolved company personnel. It is extremely important, however, to assure that such an audit is applied as rigorously as it would be had external consulting engineers been contracted to carry out the work.

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[15] See Carl H. Fromm and Michael Callahan, "Waste Reduction Audit Procedure—A Methodology for Identification, Assessment and Screening of Waste Minimization Options," in *Waste Minimization Programs*, pp. 427-435.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

Since it is not possible to determine ahead of time what actions companies would take on the basis of mandatory waste audits, it is not possible to predetermine what volume reductions waste audits would achieve. Statistics are not available on average levels of waste reduction following waste audits. Certainly some reductions would be achieved, especially in plants that would have chosen to undertake such audits on a voluntary basis. So long as there is no specific requirement to achieve reduction or recycling levels based on audit results, companies would be likely to act only in circumstances where they saw benefits in terms of reduced liability, reduced disposal or compliance costs, or reduced raw material requirements. These conditions are analogous to those that would lead to action by generators under the technical assistance program option.

If the results of waste audits were to make certain actions mandatory, volume reductions would probably be substantially increased. But such an approach would have most of the disadvantages of a performance standard program (high development and implementation costs—see below) without the compensating advantage of careful economic and engineering studies of what could reasonably be required of an waste generating sector. It would at least be necessary to require feasibility studies to determine which of the possibilities identified in the waste audits were truly viable. If this were done on a site-by-site basis, the management burden on EPA and on the States would, in fact, be many times greater than under a performance standard. EPA would at least need to establish threshold criteria for combinations of waste minimization and economic tradeoffs that would compel action by a company.

Toxicity Reduction

As with reductions in volume, it is impossible to predict the actual reductions in toxicity that would result from mandatory waste audits. Unless some incentive were given for reductions of the more toxic hazardous wastes, however, it is likely that waste audits would have a proportionately larger impact on volume than on toxicity. Most of the market incentives affecting such decisions would tend more to encourage reductions in volume, since it is volume that most influences disposal costs as the waste management system is currently structured.[16]

2.2 Impacts on Industry

Economic Impacts

The cost of a waste audit depends on such factors as its scope, the size of the plant, the number of waste streams involved, and whether the audit is done by a company's staff or external consulting engineers.

One engineering firm, for example, suggests the following as a cost profile for a facility of medium complexity (i.e., three to six different waste streams with up to four different production steps). The audit would require seven to eight engineering person-weeks. Costs per hour for external consulting engineering services would be in the range of $60 to $65/hour. If done by company staff, costs would be about $35/hour. Therefore, the resulting cost range for a waste audit for such a medium–sized facility could range from $9,800 to $20,800. For smaller facilities, the costs could be substantially lower, perhaps under $5,000, and for large, complex facilities, the costs could be substantially higher.

Whether the demand for services created by such a requirement would drive costs higher is not certain. A substantial reservoir of engineering expertise in environmental auditing and value engineering already exists and could, with limited reorientation, be available for carrying out waste audits. The effect of such a large, one-time demand, however, is difficult to project.

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[16] Under some options, such as certain variations of phasedown permits, reductions in toxicity *per se* might be emphasized by such measures as higher permit costs for more highly toxic wastes. EPA's analysis at this point suggests that trying to set up separate incentive structures for volume reduction versus toxicity reduction would raise many complex technical and implementation issues. It may happen, however, that under the land disposal restrictions program costs of treatment of high-toxicity wastes may in certain circumstances be higher than costs for lower-toxicity wastes. If this occurred, it would provide an independent market incentive for firms to reduce waste toxicity.

Recognizing that these figures provide no more than the roughest estimates, if waste audits were required for all but the small quantity generators and a midpoint of $15,000 were selected as the cost figure for audits of all such facilities, the cost to the 43,000 generators identified in the 1983 biennial report would be approximately $645 million. If a figure of only $3,000 were selected as the cost for waste audits of small quantity generators, the cost of such audits for those generators would run to an additional $525 million. It must be kept in mind, however, that these costs include only the waste audits themselves. They do not include the costs of subsequent engineering, feasibility studies, or implementation of the proposed changes at a plant.

Equity

If waste audits were applied on a voluntary basis, no new administrative burdens would be imposed on firms, and equity concerns would not be a significant issue.

Some concern might arise if the information generated by audits were to be made available to EPA or the States. Firms might fear that proprietary information might be made available inadvertently to competitors.

If audits were selectively applied on a mandatory basis, equity issues might become a more serious issue, particularly with regard to inadvertent disclosure of proprietary information. If requirements were included to *compel* firms to adopt the recommendations of audits, equity concerns would presumably be substantial. Fortunately, a mandatory waste audit program would not tend to penalize firms that had already invested in waste reduction: the audit would simply reveal that such firms have less additional opportunity to reduce or recycle wastes.

Incentives for Noncompliance

If implementing the results of waste audits were *not* mandatory, then "noncompliance" with the option should be realistically defined as noncooperation with the process. Firms presumably would not deny access to plants by authorized and accredited auditors.

The principal negative effect of mandatory waste audits would be that companies may treat waste audits as a regulatory imposition rather than an effective management tool. Resentment might be further exacerbated if a facility were required to undertake the audit in spite of substantial previous waste minimization activity. The result might be that, even though more audits would be done than under an active technical assistance program, less follow-through action based on the audit results would be carried out by the plants. Furthermore, plant personnel might resist the audit process and deny auditors relevant information, rather than cooperate with them as potential contributors to the plant's more efficient and profitable operation.

Industry would also be concerned that such a program could risk proprietary information. In order to identify waste streams and the processes that generate them, a tremendous amount of confidential information would need to be gathered. If the audits are subject to review, they risk divulging this information when the report is forwarded to EPA. Under these circumstances, management may be less than candid about the information that would go into an audit report.

If implementing the results of waste audits were made mandatory, noncompliance would clearly be a major issue, with serious implications on State and Federal enforcement budgets (see below).

2.3 Implementation Issues

Legislative Authority

If waste audits were promoted by EPA as a voluntary measure, no additional legislative authority would be required.

While waste audits are less comprehensive and objective than a complete environmental auditing program, EPA believes that the interim guidance adopted by the Agency for environmental auditing (50 FR 46504, November 8, 1985) is appropriate for waste audits. This guidance states that, "because environmental auditing systems have been widely adopted on a voluntary basis in the past, and because audit quality depends to a large degree upon genuine management commitment to the program and its objectives, auditing should remain a voluntary activity." A possible exception to this voluntary approach would be in enforcement actions, "where auditing could provide a remedy for identified problems and reduce the likelihood of similar problems recurring in the future." Though the Agency is reluctant to interfere with the long-term impact of a waste audit, it may on a case-by-case basis, request reports if "...[it] determines it needs an audit report, or relevant portions of a report, to accomplish a statutory mission...."

Requiring a waste audit of all generators would at least require a rulemaking procedure. It might be necessary to obtain direct legislative authority, although such authority might be argued to already exist under Section 8 of TSCA: requiring waste audits of all generators in specific industrial categories, because of specific toxicity and health concerns related to that industrial category, would be more clearly the kind of information gathering permitted under Section 8. If mandatory audits were applied selectively rather than across broad industrial sectors, use of existing authority under Section 8 of TSCA might be feasible. The difficulty would be in demonstrating a need for such information to be developed by all generators for effective operation of TSCA—particularly if it were not the Agency's intention to require the information for themselves. Passage of some of the informational requirements proposed in the CERCLA amendments, however, would probably provide the requisite authority. Otherwise, the Agency would have to depend on a further modification to RCRA.

Time Required for Implementation

If waste audits were supported by EPA as a voluntary program, individual firms could begin to plan and conduct audits as soon as funds were allocated for this purpose.

Since new legislation followed by a rulemaking would probably be required to make waste audits mandatory for all industries, it would take a considerable amount of time before the impact of a mandatory program would be visible. Impacts could be felt sooner if current proposed information requirements amending CERCLA are passed by Congress. Assuming that the current CERCLA amendments pass by the end of 1986 and that rulemaking is to be completed by the end of 1987, the requirement would most likely be implemented between late 1988 and early 1990. Implementation of recommendations from the audits would occur over subsequent years. If such authority is not created under CERCLA, separate legislative authority under RCRA could be passed by the end of 1988, which would delay the timetable by two years.

If EPA decides to implement waste audits on an industry-by-industry basis, a rulemaking under Section 8 of the Toxic Substances Control Act might be feasible. The timetable could be shortened by nearly a year.

Appropriate Target Industries

The industry studies in EPA's technical background document on waste minimization, for example, indicate that epichlorohydrin manufacture, 1,1,1-trichloroethane manufacture, trichloroethylene/perchloroethylene manufacture, and vinyl chloride monomer manufacture (all of which are part of the organic chemicals industry, SIC code 2869) are all carried out at a few very large facilities. Engineering reviews in these studies indicate that the plants involved have already taken substantial steps toward waste minimization and are generally well controlled. But such wastes as heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production (K020) and heavy ends from the distillation of ethylene dichloride in ethylene dichloride production (K019) are (according to currently available data) among the largest volume RCRA waste streams; they are also produced from plants that are parts of integrated operations. The organic chemicals industry, taken as a whole, is the largest single generator of RCRA wastes and produces the most toxic wastes.

Another type of industry group to which a waste audit requirement might be applied would be a generator group characterized by large numbers of smaller facilities, significant commonality in operations, and the generation of large volumes of highly toxic wastes. A principal example would be the electroplating industry (SIC code 3471).

Waste audits may actually be useful over the entire range of industries. While it might be argued that certain industries will benefit more from a requirement that they conduct a waste audit, many other industries might also find it a helpful way to identify waste streams and the production technologies that generate them. Knowledge of the wastes and techniques that generate them can be a preliminary step by a firm in determining what appropriate actions it may take to reduce waste generation.

Costs of Development and Implementation

If all facilities were required to undertake a waste audit, the only development and implementation costs for government would be the costs of notifying all generators of the requirement. Substantial additional costs would be incurred if a decision were made to subsidize waste audits for small quantity generators, or if EPA were to decide to analyze audit results.

If EPA requires that a facility, upon completion of an audit, implement feasible changes identified in the audit, it would drive enforcement costs into the range estimated for standards of performance—about $7.5 million annually.

Other Impacts

The major benefit of a mandatory waste audit program would be that companies, once made aware of changes that would enable them to minimize wastes, would take action to achieve feasible reductions, insofar as there was an economic reason to do so.

Such a program could be described in a way that would be appealing to the public, since the requirement could be seen as encouraging industry to take further steps toward waste minimization. It is not clear, however, that the actual results would provide greater, or even equal, protection to the public than voluntary State technical assistance programs encouraging generators to undertake audits on their own volition.

Impacts on States: Requiring waste audits might undercut State technical/financial assistance programs by creating an adversarial situation with respect to the very kinds of services being offered by the States. If many generators were to be less responsive than they would be when management initiated a waste audit effort, the result could be to limit the actual impact of some of the facets of the State programs, which depend on an effective waste audit, or on effective State and generator cooperation.

3.0 Recommendations

Waste audits can be extremely useful in diagnosing the ways in which a facility can reduce or recycle wastes. The information developed during such an audit can be a valuable step in making plant management aware of changes in processes, operating practices, and management of wastes that could save on disposal costs, reduce raw material demands, increase efficiency in meeting compliance requirements under other environmental statutes, and/or reduce future liability concerns.

Notwithstanding these advantages, EPA believes that such waste audits should remain voluntary. EPA believes it is preferable to support State technical assistance programs and to encourage the inclusion within those programs of a waste audit component.

A crucial element in the success and usefulness of such audits is the recognition of the audit's value by a facility's management. There is a greater probability that waste reduction innovations will be incorporated into redesigned plant operations if an audit has been initiated by management. If waste audits are imposed as an external regulatory requirement, this commitment might often be lacking; suspicion that EPA may sooner or later use the results of the audit to require specific changes within the plant may tend to limit the audit's effectiveness. An uncooperative attitude would also reduce the likelihood that the results of the audit would be used effectively by the plant in altering its operations to minimize wastes.

Technical Assistance Programs

1.0 General Summary

EPA already provides some technical assistance to certain active State waste minimization programs. The range of potential additional technical support activities could, however, be broadened substantially and its level of intensity significantly increased. Not all States have waste minimization technical assistance programs, and among those that do, the scope and depth of activities vary widely. The option under consideration here is whether or not an expanded EPA-supported program would be an effective and desirable method of encouraging firms to adopt affirmative waste minimization programs as part of their hazardous waste management agenda, and if so, to suggest the priorities for developing such a program.

Generic elements for an expanded program might appropriately include:

- Technical information development and transfer;
- Increased coordination and cooperation between EPA- and State-supported activities, including direct outreach to firms; and
- Cooperative research on source reduction and recycling methods.

It is important to note that the success of this approach is not to be based exclusively, or even primarily, on the civic concerns of the companies involved. Because companies can choose not to participate in these programs, such nonregulatory approaches to environmental problems are sometimes viewed as noncompelling—"voluntary" almost in the sense of public philanthropy. A crucial and powerful element in the success of a technical assistance programs for the minimization of hazardous wastes is that they do not operate in isolation from the economic realities that drive the firms generating those wastes.

Several factors are involved in a firm's search for solutions to its waste generation problems, or its receptivity to the information provided. These factors include current regulatory requirements (e.g., Clean Air Act, Clean Water Act), steeply rising waste management costs (which may increase further as land restrictions are implemented), future liability concerns, and potential for savings through recycled materials. Many of the hazardous waste generators subject to these pressures face obstacles to implementing waste minimizing processes or practices, because they lack awareness of the technical alternatives available, have inadequate capital to make the necessary investments, lack engineering expertise to redesign processes, or fail to understand the importance of considering compliance or disposal costs in time/cash flow calculations.

The principal point is that, while the incentives listed above not are as compelling as an enforceable performance standard, they do in fact lead generators to act voluntarily to reduce wastes. Some generators, however, will probably not be subject to these pressures, or at least not to the extent that they will change their operating practices. Identifying these industrial sectors, and the percentage of wastes they contribute, thus will not likely become apparent until the programs and external financial and compliance pressures have had some time to operate.

In general, EPA-supported technical assistance programs have had uneven and limited success. Often support levels have been not been adequate to develop strong State programs, or to ensure that they are sustained long enough and predictably enough to reach their potential. Moreover, technical assistance *per se* has often been considered inconsistent with EPA's primary identity as a regulatory agency. If an expanded technical and program were found to be a desirable and feasible means of achieving waste minimization, adequate resources would have to be available both to spur individual State efforts and to provide a centralized information and direction upon which the States could rely. The program would have to have a distinct and well-defined purpose and be integrated into the Agency's overall waste minimization strategy. While the funds required would be small relative to a typical regulatory program, they must be reliably provided if State efforts are not to be undercut after initial commitments are made. If funding for this option is considered "soft" (i.e., subject to unpredictable reduction or termination), it is likely that this option would not be successful.

To avoid such pitfalls, a waste minimization technical assistance program would have to be designed as a close adjunct to existing Federal and State hazardous waste programs, facilitating the regulatory goals of the rest of the RCRA effort and exploiting the incentives for waste minimization that these regulatory programs have partially created. Opportunities exist to build on:

- The HSWA objective to strengthen the States' basic implementation role for hazardous waste management;
- States' direct experience with the problems and priorities of local generators and TSDFs; and
- Industry's existing economic incentives to minimize waste, created in large part through the land disposal restrictions program and other HSWA initiatives.

Combining the generic elements of possible technical assistance programs with these more focused opportunities for success in relation to RCRA objectives, a long-term assistance program might well include the following specific elements:

- Identification of industries and waste streams creating the largest hazardous waste problems for each State. While much of the impetus for this process may come from the RCRA program, a non-regulatory technical assistance program offers an opportunity to look at the pollution generation problems in a cross media perspective.
- Analysis or survey of the barriers to waste reduction in the industries identified. In some cases, the barriers may be strictly informational (as with many of the smaller generators). In other cases, there may be genuine technology problems (e.g., the limitations imposed by the rapid technological changes in the electronics components industry) or lack of staff engineering skills that can be dedicated to waste minimization problems (depending, to some extent, on the proportion of production costs represented by waste management or the potential savings from recovered product).
- Evaluation of whether and how the various technical, and informational options described above could meet the needs or overcome the unidentified obstacles. It is also necessary to determine the appropriate allocation of effort and funds for overcoming each obstacle. At this early stage, the combination of effort and funds will be somewhat subjective until hard evidence has been developed for the cost–effectiveness of specific approaches.
- Focusing aid over the long term on those elements of a technical assistance program where EPA can effectively gather, collate, and analyze data on a nationwide basis. For example, EPA assistance

may be most helpful in the identification of common industrial and waste stream problems, development and cataloguing of model solutions to those problems, and analysis of typical financial tradeoffs. While these factors obviously vary with the characteristics of individual States, or with the particularities of individual plants, the useful common base of information will generally be substantial.

- Providing support to the States for activities that would generate useful new information. EPA could assist, for example, in supporting waste audits conducted as part of State technical assistance programs. Such support would be particularly appropriate where a State has industries with highly toxic waste streams on which little information has been developed about opportunities for waste minimization.

- Highlighting ongoing research and development efforts that might serve a larger area than a single State and that would enhance waste minimization by large numbers of generators. Some of this support may be as much a matter of planning as financial assistance. Central facilities for handling and recovering wastes generated by electroplaters, for example, are in the planning and/or feasibility study stages in New Jersey, Illinois, and Minnesota. Such central facilities have the potential of serving large numbers of generators who would otherwise dispose of their wastes in landfills or other land disposal sites. The problems involved in implementing such a project are technical, financial, and regulatory (the relationship of the implementation schedule, for example, to compliance deadlines under the Clean Water Act's pretreatment program). Because of the broad potential for waste minimization in such centers, EPA could usefully provide technical and planning assistance.

Almost all of the State assistance programs are relatively new. In some States major resource commitments have been made, and substantial efforts to develop a waste minimization program are underway. These programs disseminate information on waste minimization technologies and practices to generators. Other States have offered financial assistance to generators to make investments in waste reduction or recycling technologies that they might not otherwise make. A signficant EPA commitment to supporting programs could be instrumental in accelerating the growth of existing State programs and the initiation of new programs in the remaining States.

At its most basic level, technical assistance has meant providing a library resource of technical information that generators can review to learn which technologies would be useful for minimizing their own wastes. New York and North Carolina both have established significant technical information collections available for use by generators (or by other State agencies providing more direct technical assistance to generators). New York's Industrial Materials Recycling Program, operated through the State's Environmental Facilities Corporation (EFC), publishes informational newsletters, technical papers, and a directory of permitted hazardous waste transporters. North Carolina's Pollution Prevention Pays (PPP) program has an Information Clearinghouse with over 1,200 references on waste minimization methods organized by SIC code. Numerous other publications are also available through PPP, such as the *Handbook of Environmental Auditing* and a directory of State recycling firms.

Some States have developed more active technical assistance programs. These include direct efforts to help individual generators and educate important industry groups. Minnesota, North Carolina, and Illinois, for example, provide direct advice to individual generators. Most of the direct assistance to individual generators is provided by telephone, followed by distribution of appropriate written information. Technical assistance staffs in each of these States also provide onsite audits and reviews of particular plant sites. Since onsite audits are resource intensive, often involving an effort of several days, it is important that the sites selected represent prevalent industry problems within the State.

Minnesota has carried onsite technical assistance a step further by providing plants with engineering students who work directly in the plant during the summer to assist in assessing the needs and opportunities for waste minimization. During the summer of 1985, several of these interns worked on problems involving electroplating and spray coating, two industrial processes of major importance in Minnesota. While most of the plants were smaller companies, one intern worked with Sperry Corporation, redesigning its metal plating processes so that wastes could be segregated and the metals recovered (rather than disposed of as hazardous wastes). Other States are considering the possibility of establishing senior intern positions for retired engineers who could provide the benefit of their experience to smaller companies to assist them in designing and implementing waste minimization options.

Several States have designed seminar programs for specific industrial sectors. The seminars try to cover sectors that either exhibit the most need and potential for waste reduction or are the greatest volume generators. Tennessee, for example, has developed a list of several initial target industries. After completing waste audits for representative companies in each of the industrial sectors, seminars will be held throughout the State incorporating the results of the audit and other relevant technical information to help educate those industry groups on waste minimization opportunities.

Beyond technical engineering advice, considerable effort has gone into developing information on the economics of waste minimizing processes, documenting for smaller companies either the direct cost savings from recovered materials, or the net savings resulting from reduced disposal costs. North Carolina, for example, funded several case studies of cost savings from installation of processes to reduce wastes.[17]

Technical assistance programs also provide support in the area of research and development (R&D), along with planning and feasibility studies that target industries are often unable to initiate on their own. This aspect is illustrated by studies that have been undertaken in both Illinois and Minnesota for a centralized facility to process electroplating wastes. R&D has determined that such a facility, depending on its design, can either recover the metals directly for reuse or make use of other recovered material. Not only does it have the potential for substantially lowering the costs of the generator, but it can also reduce the total volume of waste that would otherwise have to be disposed of. The planning and feasibility studies stated that, for the centralized facility to be economical, a large number of electroplating processors would have to be willing to send their wastes for processing.

Research and development support for technical assistance efforts can also take the form of grants to universities to investigate alternative technological approaches to waste minimization. The results of this research can then be used by generators in the relevant industry group within the State. For example, North Carolina this year has funded studies on topics relating to pollution reduction systems for selected food processes and a new method for recovering metals from aqueous waste solutions.

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[17] Some of the North Carolina case studies are available in summary form from the PPP program; others have been published in *Proven Profits from Pollution Prevention*, by the Institute for Local Self-Reliance.

Direct financial assistance to generators is provided through a variety of State loan and grant programs. Financial support is sometimes provided for installation of waste reduction or recycling equipment or processes, waste audits by generators to determine the opportunities for waste reduction, or research done directly by the generators on their own plant sites. The goal of such research is to develop processes or technologies that will be transferable to other generators using the same types of processes or producing similar products.

Loan assistance is available through mechanisms ranging from tax deferred bonds and defrayal of loan costs to direct loans. California's Pollution Control Financing Authority, for instance, has the authority to subsidize loans for small and medium-sized generators for the cost of purchasing waste reducing equipment. The Financing Authority has $2.6 million to invest in these activities or in financing the cost of issuing revenue bonds.

Illinois provides financing for waste reduction investments for generators through environmental control revenue bonds. The interest on the bonds is exempt from Federal taxes, which lowers the interest costs on the loans to the generators. The State, however, does not stand behind bond repayments; that is strictly the responsibility of the borrower.

Minnesota offers research grants to generators or groups of generators to study the applicability of known waste reduction processes to other waste streams or processes. Generators can receive up to $30,000 for such a research project. North Carolina provides up to $5,000 in "Challenge Grants" in matching funds to firms (or communities).

Some of the money distributed by States has been supplied by EPA. Some examples include the following:

- Georgia's Hazardous Waste Onsite Consultation Program has been partially funded on a pilot basis by EPA.

- Tennessee's program to identify, analyze, and develop training seminars for various industries received $90,000 of support from EPA for a 15–month period that began in the fall of 1984.
- North Carolina's research grant program has EPA funding of $100,000/year for three years. Minnesota has also received $100,000 for support of a research program.
- Small quantity generator audits in New York are supported by a $30,000 grant from EPA.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

It will be difficult to predict or to measure the impact of technical programs on waste generation rates, but the Agency believes it is potentially substantial. Both direct and indirect effects must be considered. Direct technical assistance would presumably focus on small and medium–sized companies, not the largest generators, since the large firms tend to have greatest access to information and capital to support waste minimization programs. A sustained and well-publicized program would, however, help change the general climate within which firms make waste management decisions, exploiting peer pressure and creating a milieu in which firms can demonstrate technological leadership and innovation in a field where public anxieties are great.

State technical assistance offices indicate that the largest reductions in disposal of hazardous wastes as a result of the technical assistance provided to generators are taking place through increased recycling of spent solvents (F001 to F005)—solvent wastes are produced in significant volumes by a number of different industries. Also identified are generators of electroplating sludge (F006), one of the largest volume RCRA wastes, as candidates for future waste minimization technical assistance.

Toxicity Reduction

As with volume reduction, the degree to which technical assistance programs could help reduce waste toxicity is still speculative. However, although high-volume wastes tend to be associated with large firms, the same is definitely not true with high-toxicity wastes. Some categories of industries dominated by small and medium size firms are known to generate highly toxic wastes; examples include electroplating operations and pesticides formulators. Technical assistance could potentially have a significant beneficial effect on the toxicity of wastes produced by large numbers of firms.

Other Issues

Multimedia Issues: One advantage of expanded technical assistance programs is that they could encourage thinking about environmental problems on a cross media basis. Waste audits and technical assistance provided to companies generally focus on the entire pollution generation profile of a company—not just RCRA wastes.

2.2 Impacts on Industry

Economic Impacts

A technical assistance program would create no new costs for industry. It has the potential to lower some costs that would otherwise exist by making companies aware of cost saving approaches to reducing and recycling wastes, by directly financing installation of waste reducing technologies, or by implementing waste minimizing practices. For example, a technical assistance program might be useful in lowering costs by aiding a company facing compliance requirements for effluent or air standards. Employing information from a technical assistance program to develop an overall waste minimizing strategy might be more cost-effective than just satisfying minimal performance requirements under the applicable standard.

How well a technical assistance program works depends on the other costs industry faces. Where disposal, compliance, and potential liability costs are high, there will be greater concern with finding waste minimization opportunities. Costly technical, instructive, and economic information might prevent smaller companies from being able to research opportunities with their own resources. State programs that remove or reduce some of the cost barriers may, therefore, have a significant impact on company decisions.

Equity

No major negative equity issues arise under a technical assistance program. This approach provides a benefit for industry, enabling it to find more cost-effective approaches for compliance with environmental program standards and providing incentives for waste reduction, which, over the long term, could reduce disposal costs or create savings through materials recovery.

Incentives for Noncompliance

Since this option carries no mandatory requirements for industry, noncompliance is not a direct issue in this evaluation.

The General Accounting Office report, *Illegal Disposal of Hazardous Waste: Difficult to Detect or Deter*,[18] recognized the potential enforcement problems of HSWA generally, and pointed out that current State and Federal enforcement capabilities are limited in their ability to cope with the extent of the illegal dumping problem. Because this option provides incentives for small quantity generators and other small facilities to seek the assistance needed to help overcome the high costs of meeting regulations on treating or disposing of wastes, it may offer some promise of limiting the problem of illegal dumping.

2.3 Implementation Issues

Legislative Authority

Existing authority is sufficient to set up the programs contemplated within this option; no additional legislative authority would be necessary. The only legislative requirement would be for increased appropriations to ensure that there is a coherent and predictable program effort for several years. Such a commitment might well make implementation of some of the costlier alternatives for achieving waste reduction and reuse unnecessary.

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[18] General Accounting Office, February 22, 1985, *Illegal Disposal of Hazardous Waste: Difficult to Detect or Deter*, GAO/RCED-85-2.

Time Required for Implementation

Several States have already initiated technical or financial assistance programs, some with EPA support, as a significant proportion of their budget. Both State and EPA funding has also been provided for research into waste minimization potential in specific industries.

EPA could accelerate and expand efforts in some States, spur the creation of programs in other States with no current programs, and boost the research efforts that help these programs to develop more effectively. The effects of these additional program and funding efforts would be relatively direct and immediate. Support directly to technical/informational assistance would show results earliest, since these would be used within the year allocated for activities such as information dissemination and waste auditing. Plants might begin acting on the information or analysis received within a few months. The longest time periods between funded programs and actual impact would be during the research phase, where the time involved would depend on the duration of the research project and the extent to which results would be directly applicable. For example, the market research construction and operation of oil/water separator sludges would probably take a number of years to complete. Other projects involving research into the transferability of existing technology into plants in other industries might show quicker results.

Appropriate Target Industries

State technical assistance programs have focused on the industrial sectors identified as serious sources of problems for in-plant assistance and for general education programs. Many State programs have highlighted the problems of small quantity generators for attention, while others have placed as much or more emphasis on medium–sized generators. This is important because in some States the medium–sized generators are producers of the largest portion of the wastes, yet they often lack the resources and expertise to identify and/or implement waste minimization activities.

Metal finishing/electroplating has been a major industry of concern in almost all the States with active technical assistance programs. The industry is characterized by large numbers of smaller plants that produce substantial volumes of highly toxic wastewater treatment sludges with cadmium, chromium, copper, nickel, and other metallic wastes. Similar waste streams constitute a large proportion of the hazardous wastes generated by the printed circuit board industry, which is also characterized by a large proportion of medium-sized and smaller facilities. Within individual electroplating plants, there are a number of steps that can reduce the generation of wastes, including minimization of drag-out from the plating bath to a rinsing bath (through increased solution temperature, decreased concentration of metal salts and other components of the plating solution, or reduced period of withdrawal), segregation of waste streams, or reduced use of rinsewater by recycling.

In-plant waste audits, educational seminars, and publication and distribution of relevant engineering information may facilitate adoption of waste minimization changes in operating procedures. In some cases, it will require financial assistance from the State in order to make it more feasible for a small plant to implement changes.

It should be noted that while the emphasis is on smaller or midsized facilities, it is not limited to them. Tennessee's initial outreach was to generators of all sizes, though State officials do not expect substantial participation by the very largest firms (partially because their technical resources are greater and partially because of concerns about proprietary information). In Minnesota, although most engineering interns were assigned to smaller firms, one was assigned to a plant for Sperry Corporation to identify potential ways to reduce electroplating wastes in the facility.

In the electroplating industry, there is an opportunity for cooperative technical efforts involving States and generators. In areas where there is a large concentration of plants generating electroplating wastes, States and generators may be able to jointly sponsor construction of a central processing plant, which will make possible greater waste incentive in circumstances where the waste minimization techniques will involve longer term cost savings resulting from foregone environmental compliance costs (e.g., pretreatment requirements for electroplaters) or decreased raw material requirements (e.g., through recycling of pigment dusts in paint manufacturing). Projects that would benefit large numbers of small generators, such as the centralized metal wastes processing facility discussed above, could be financed through a public authority with general revenue bonds. This would essentially amount to a subsidy of waste minimization costs for all participating facilities; the extent of the subsidy would depend on subsequent fees charged the companies.

Grants for research do not have to be large to assist in meeting the waste reduction requirements of smaller companies. For example, a challenge grant (maximum $5,000) was given to a firm in North Carolina to assess the market feasibility, and design a plant, for a vehicle maintenance wastewater pretreatment facility to recover used oil and grease from oil/water separator sludges at vehicle repair and maintenance shops. Over a thousand potential users in several counties were identified, and it was estimated that such a plant would require a 1.3 million gallon/year capacity.

Targeting industries for technical assistance is primarily a State role. This would include research dollars invested in studies on technology and technology transfer, multi-State market analyses for waste recycling and treatment, and economic analyses of common difficulties in an industry. Many of the industries listed below—e.g., electroplating, printing, painting and coating—might be appropriate focuses for EPA efforts that go beyond support of State technical assistance programs.

The type, number, and size of industries that might be targeted for this option are listed below. The sectors include a large number of medium– and smaller–sized facilities.[19] These industrial sectors are:

- Paint manufacturing (SIC 2851)—1,321 of 1,441 facilities have fewer than 100 employees.

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[19] Data from Appendix B of *Waste Minimization:Issues and Options*, USEPA Office of Solid Waste, February 17, 1986.

- Electroplating (SIC 3471)—3,349 of 3,450 facilities have fewer than 100 employees.
- Wood preserving (SIC 2491)—511 of 524 facilities have fewer than 100 employees.
- Organic dyes and pigments manufacturing (SIC 28652/3)—118 of 189 facilities have fewer than 100 employees.
- Printed circuit board manufacture (SIC 3679)—286 of 585 facilities have fewer than 100 employees.
- Agricultural chemicals formulation—302 of 330 facilities have fewer than 100 employees.
- Printing operations (SIC 27)—51,155 of 53,356 facilities have fewer than 100 employees.

Costs of Development and Implementation

Although EPA support of State activities is desirable, long-term general support of technical assistance programs involving loans, loan guarantees, or defrayal of interest costs is a relatively high cost State-specific effort. EPA's role in such programs is not likely to provide a major impetus to State action, nor will it be more cost–effective than the States' own efforts. In any case, EPA's role would be unlikely to match in importance the current Federal subsidy role allowing States to issue tax free bonds to finance pollution control investments (at least so long as this subsidy is not eliminated in the tax reform legislation). These types of programs should be left to the States to fund where they believe such funding is beneficial and appropriate.

Costs to EPA for development and studies under this program would include funding for technological research, for additional personnel to manage the program at the Agency, for a computerized information system accessible by the States, and for analyzing impacts of the State's efforts. The costs for each of these are variable, depending on the scope of the program. Current ORD funding to the States for research programs, for example, amounts to $300,000 per year (though current planning calls for phasing this down to zero by FY 1988).

A possible program would call for the implementation and maintenance of a computerized information system (perhaps $100,000 a year for developing the system, gathering, analyzing, and entering available data); an EPA supported research effort of $500,000/year; and two additional personnel each in OSW and ORD ($275,000 total costs) for planning, program analysis, and research.

EPA could provide direct support to the technical assistance programs of the States of from $2.5 to $3 million in the first year and some front loading of expenditures in the early years thereafter. The direct support would consist of grants to States beginning their programs (of perhaps $50,000 to $100,000), and smaller support grants after the first three years. Since not all States would begin their programs simultaneously, the peak years would probably be the second through the fourth years. This would be a substantial program for EPA, which would provide significant support for making State programs effective.

Even if direct financial assistance to generators from the Federal Government were a desirable objective, it is not a feasible one under current budget constraints. With respect to direct technical assistance to the generators, the States are far more directly involved with local needs, and the delegation of hazardous waste control programs to the States is one of the stated objectives of RCRA. EPA's activities under this option, therefore, would be twofold. The Agency would provide support to the States to assist them in their own technical assistance efforts. EPA would also provide centralized services and support that would be inefficiently provided if done by each State. These lines are not, however, absolutely distinct.

The option under consideration would involve an expansion of EPA's current level of support of these or similar State efforts, as well as coordination with the States for the provision of services and capabilities that can most cost effectively be provided on a centralized basis. In particular, EPA could facilitate the rapid dissemination of each State's research and experience to the other States. This would be particularly helpful for the States that have not yet undertaken waste minimization programs.

To facilitate the rapid dissemination of each State's research and experience to other States, EPA could develop a computerized information system on waste minimization. It would be accessible by the States and would include elements such as the following for particular industries or waste streams identified by the States or EPA as important or problematic:

- Technical literature on the options available to achieve waste minimization for the particular industry or waste stream;
- Types of technical assistance provided by various States to a particular industry group, and resultant changes in waste reduction or reuse practices;
- Highlighting of ongoing or planned demonstration or research projects and their status or results; and
- Economic analyses of the investment costs and recovery periods typically experienced with respect to available waste minimization options in an industry. Analyses of costs and results of various approaches to technical, informational, and financial assistance practiced by the States (these studies would be carried out cooperatively with the States).

State costs could vary substantially and would depend both on the scope and nature of the State commitment. North Carolina's PPP program, one of the most extensive technical assistance efforts, has been funded for three years at $500,000 per year (with an additional $100,000 from EPA). Minnesota's MnTAP program has received $180,000 from the State (in addition to $100,000 from EPA). California established a capital fund, the Hazardous Waste Reduction Incentive Fund, at $5.2 million, of which $2.6 million is available for tax exempt bond financing and other forms of credit through the California Pollution Control Financing Authority (although this would not be exclusively for waste minimization by generators). Other States (e.g., Tennessee) are planning several million dollar investments in technological research to support the technical assistance efforts (an effort where effective EPA coordination with the States could increase the cost–effectiveness of each State's efforts). Because of the diversity of State programs and efforts to date, and the fact that some States have not yet initiated programs, it would be extremely difficult to make any meaningful generalizations on State costs.

3.0 Recommendations

EPA's current technical assistance effort is restricted. Few States receive direct support and the support that is available is limited. Research programs are selected and funded without any systematic determination as to whether their research might duplicate efforts of other States. Duplication could be avoided if, for example, prior to commissioning a specific research project a State could determine through a central data system whether other States had already undertaken or completed a similar research project. Nevertheless, some flexibility must be built into the selection process to allow for variability among States in the development of their own programs.

An active, aggressive, and sustained program for technical assistance appears to be the strongest option available to EPA and the States to promote waste minimization in an efficient manner without interfering with a generator's ultimate control over his or her production processes. It appears to be both desirable and feasible as a near-term option.

EPA therefore recommends development of an expanded support capacity for State technical, and informational assistance programs to encourage waste minimization. The Agency's primary focus should be on those elements of technical assistance programs where the EPA's contributions can be of most benefit to the largest number of State programs.

Procurement Practices

1.0 General Summary

Government procurement programs may provide a means of creating additional demand for products made with less harmful materials or for products with a higher proportion of recycled materials. This option would involve establishing procurement regulations or guidelines to encourage (1) additional recycling of waste materials in certain types of products and (2) greater emphasis on waste minimization in the manufacture of particular products.

There is ample precedent for the first part of this option. Between 1978 and 1982 EPA had a cooperative venture with the National Institute of Governmental Purchasing (NIGP) and the National League of Cities (NLC) known as the "Buy Quiet" program; the goal of this program was to encourage governments to ask for quieter products and equipment (e.g., vacuum cleaners, lawn mowers) through the competitive bidding process. A secondary goal of this program was to encourage the private sector to manufacture and market products and equipment that make less noise.

More than 200 State and local government agencies participated in the program. The participants asked for quieter products and equipment by using model specifications and bid evaluation formulas that established maximum noise levels and rewarded bidders for offering products which made less noise than the noisiest product offered, or the maximum noise level allowed by the specification.

The Buy Quiet program achieved a number of objectives. First, it showed how the competitive bid process could be used to obtain attributes other than "low bid" for the products purchased. The concept was not limited to noise; this type of program was explored by Southern California local governments to purchase vehicles and equipment that have lower air pollutant emission levels. Second, the program demonstrated that a social benefit could be obtained through the free market mechanism rather than through regulations. Third, it showed that the results could be obtained by cooperative ventures with State and local governmental agencies, rather than solely through Federal agencies. This is important, because EPA is not prohibited by any law from working with State and local agencies.

Additional recycling of waste materials could be accomplished through direct Federal Government procurement guidelines or regulations, such as the EPA guidelines recommending purchase of cement or concrete containing fly ash, or as mandated by RCRA for recycling paper. Other methods could include cooperative ventures with State and local governments such as the Buy Quiet program. EPA could help the State and local governments implement purchasing programs. There is a distinct advantage in this type of involvement rather than EPA's developing Federal procurement policies because State and local governments can often implement purchasing policies more easily than can the Federal government.

As was evident in the Buy Quiet program, implementation of the purchasing program came about as a result of shared goals of the various governments. The implementation was enhanced by extensive interaction with the private sector. Such interaction between government and private industry at the Federal level is difficult, since purchasing policy at the Federal level means the preparation and publication of guidance. That is, the guidance and implementation suggestions come from EPA, but there is little or no interaction with the personnel actually involved in the purchasing actions and decisions other than the requirement that consideration be given to the requestor.

In contrast, the Buy Quiet program is an example of dynamic interaction; that is, the institutional arrangements evolved in a grass roots style of growth that has been described as "social entrepreneuring." Such programs involve more than establishing guidelines; they stimulate dialogues among the government purchasing departments and suppliers of the items to be purchased.

EPA's role in such an effort would be as the facilitator or "social entrepreneur" to encourage State and local governments to take the lead in pursuing the increased use of recycled materials in products purchased by governmental entities. Such an effort would not be limited to recycled materials. Product substitutes would also be a goal. For example, there is no actual need for cars to have chrome bumpers; possibly cars with high impact rubber bumpers could be ordered by government agencies with large fleets of cars. Similarly, products that are cadmium plated could be plated with less hazardous materials. Soft drinks in glass bottles could replace the plastic bottles routinely disposed of in Class D sanitary landfills.

Implementing the second type of procurement activity (i.e., greater emphasis on waste minimization processes in the manufacture of particular products) is a more difficult problem to solve. The objective would be to create a preference for the purchase of products manufactured with processes that minimize the volume and/or toxicity of wastes. The difficulty lies in focusing the purchasing decision on the manufacturing process rather than on the material characteristics of the product. Products may be essentially identical, except that the creation of one involves a manufacturing process that minimizes volume and toxicity of waste.

The Department of Defense, for example, has the potential for implementing such a purchasing program. Exercising this option would require cooperation between EPA and DOD and would focus on purchases from government contractors that manufacture equipment for DOD. Agency guidance on procurement for such products could encourage manufacturers to voluntarily certify to DOD that they had instituted a waste minimization program. The certification would then be made a part of the contract with DOD. The certification statement could be the same as that required on hazardous waste manifests, i.e., that such a program be instituted to the degree that is economically practicable. One major difference, however, would be that the contract would allow DOD to check to see that such a program was indeed being carried out. Such an auditing mechanism already exists within DOD. The Defense Contract Audit Agency performs this auditing function for DOD through the Defense Contract Administrative Services Regions (DCASR). Briefly, it ensures that product quality control, as well as contract conditions, are being met. The audit teams may receive training by specialists, depending on the nature of what is to be examined. Thus, this option, if implemented by DOD, could entail training in environmental auditing, with special emphasis on waste minimization practices for the particular industry being audited.

Another mechanism exists within DOD through which this option can be (and to some degree already is being) implemented. This is through the Government Owned Contractor Operated facilities (GOCOs) in which a manufacturing facility is owned by a government agency and operated by a private firm. An example of such a situation is U.S. Air Force Plant No. 44, which is a Federally owned defense system manufacturing facility located in Tucson, Arizona. It is operated by the Hughes Aircraft Company. The Air Force is attempting to minimize hazardous waste generation at the facility, for which it has retained a consultant to perform waste audits and to make recommendations for changes that should be made in operating procedures, processes, and other methods. This type of situation offers the most control and probably represents the "ultimate procurement specification" in that it allows direct control of the manufacturing process as well as of the final product.

2.0 Evaluation

2.1 Technical Effectiveness

Volume Reduction

Volume reductions cannot be estimated at this time. To determine the impact this option would have on minimizing the volume of hazardous waste generated would require an assessment of the waste streams associated with products currently purchased through the procurement process. These products would then have to be compared with either the changes in volume if more recovered materials were incorporated into products or the waste minimization techniques incorporated in the manufacture of purchased products.

Toxicity Reduction

This is difficult to assess, since this option involves the incorporation of recovered materials into products, as well as the establishment of waste minimization practices at manufacturing facilities, rather than direct modification of particular waste streams. The degree to which reductions would occur in specific industries cannot be estimated at this time.

2.2 Impacts on Industry

Economic Impacts

Products that incorporate recycled materials may tend to be higher in cost than 100 percent virgin materials. Because costs are the driving factor in agencies' purchasing decisions, it is unlikely that this option will drive material costs up substantially.

The cost impact of the second part of the option would depend on how waste minimization is assessed by the agency auditors. If economic feasibility is taken into account, costs may not rise appreciably. In certain instances there may be cost savings.

Equity

By forcing agencies to consider using products made of recycled materials that have been perceived to be inferior to virgin products, the first part of the option may actually ensure more equitable competition among contractors who supply the government. A policy encouraging the use of recycled materials will increase competition among suppliers of both virgin and recycled materials. Similarly, government contractors using recycled materials who may have been shunned under previous government procurement practices would now be competitive with those contractors who use virgin material. For the second part of this option, there would tend to be a bias toward larger companies. Larger companies would be better able to initiate waste minimization practices than would small companies and they would often have a competitive advantage by virtue of their volume of product and efficiency of production.

Incentives for Noncompliance

This option would not create an incentive for illegal disposal because it is involved only with the creation of products and the enlistment of waste minimization in their production. Enforcement will not be an issue since the option is voluntary and self-enforceable.

The option would permit the industry to take credit for its own initiatives. The program, if implemented, would result in a shift in evaluation procedures used for procurement, so that more attention would be given to recycled materials and waste minimization. The option takes advantage of existing market mechanisms. That is, if bidders feel that they would have a competitive advantage in marketing products that contain recycled materials, or by committing to waste minimization programs by contract with the procuring agency, then they will do so to the extent feasible.

2.3 Implementation Issues

Legislative Authority

The legislative authority for issuing general procurement guidelines directed at Federal agencies exists in Section 6002 of RCRA. EPA may prepare guidelines for the use of procuring agencies. These guidelines must designate items that "are or can be produced with recovered materials." Procuring agencies purchasing any of these items for which guidelines are drafted "shall procure such items composed of the highest percentage of recovered materials practicable (Section 6002(c)(1))."

Although there is legislative authority for EPA to develop procurement guidelines for purchase of items with recovered materials, there is no requirement that guidelines be the only mechanism by which such a program could be implemented. EPA may choose to work cooperatively with various procuring agencies to help the agencies develop a procurement procedure.

The second type of procurement activity described above would also involve direct interaction with purchasing agencies (in this case, DOD appears to be the appropriate agency). It would be up to the purchasing agency to pursue a procurement waste minimization strategy. Since bidders would not be required to certify that waste minimization was being practiced, legislative authority would not be an issue. The voluntary agreement to submit to the requirement of certification as part of the purchasing contract would not guarantee procurement. It would only be one of the factors to be weighed by the purchasing agency.

Time Required for Implementation

Implementation of the option would be a continuing Agency activity. It could initially take from one to two years to develop this option if consideration is given to cooperative arrangements with other agencies (such as the Department of Defense) and audit training programs (associated with greater emphasis on waste minimization in the manufacture of particular products). It would take another two years for EPA to write procurement guidelines, if this were to be part of the option. The earliest the program could be fully developed would therefore be 1989, with final guidance to States and local governments being issued no earlier than 1991.

It is difficult to judge when effects would be visible. Changes in purchasing trends could occur within one year's time (i.e., by 1987), depending on the emphasis placed on environmental considerations by the purchasing agencies.

There is an advantage in EPA's moving rapidly to coordinate with DOD in developing procurement strategies and studies related to them because DOD is currently in the process of developing a comprehensive waste minimization strategy. DOD may be more receptive than at other times to altering procurement specifications and procedures. EPA coordination with DOD would take advantage of a ready-made mechanism for consideration of new ideas.

Appropriate Target Industry or Industries

This option would be directed toward internal changes in Federal procurement practices to ensure against biases in the purchase of recycled goods. The second part of the option (waste minimization processes rather than product content specifications) would concern manufacturing industries. At this time, it appears that the printed circuit (P–C) board industry would be most affected by such an option, since P-C boards are key components of communication and computer equipment that is purchased extensively by DOD; however, this option would not be focused exclusively on this industry.

Costs of Development and Implementation

The costs of implementing this option would be similar to those of programs such as the environmental auditing or the emissions trading programs, in which EPA developed guidance to "help agencies to help themselves."

Enlistment of both aspects of this option (procurement of recycled materials and emphasis on waste minimization processes) would require an examination of the types of virgin materials used in products. Where a substitution of a recycled waste may result in a substantial reduction in hazardous waste generation, a procurement policy involving these materials could then be pursued. For example, many government agencies purchase automobiles for their fleets. High impact rubber could be substituted for chrome bumpers, thus reducing the generation of wastes containing chromium. An analysis would need to be made, however, of the wastes associated with production of the high impact rubber bumpers to determine whether the substitute product results in a decrease in toxicity of waste produced.

Additional data would be necessary prior to any decision making regarding the type of materials and products purchased by the government and the production processes that may lead to a reduction in waste. These data are:

- The amounts of products purchased by various government agencies, and volumes and types of hazardous wastes associated with such products (e.g., cars with chrome bumpers, cadmium plated products that could be plated with less hazardous materials; plastic beverage bottles as opposed to glass). These data would be used as a baseline against which reductions in wastes (resulting from changes in procurement policy) could be assessed. This information would be essential in targeting types of products and purchases that would result in significant reductions in hazardous waste generated and/or treated, stored, or land disposed.
- Data on substitutes for various products and their toxicity relative to the original product.
- The amount and types of hazardous wastes associated with P-C board production, as well as the approximate quantity of such equipment purchased by DOD.

Incorporation of recycled materials in products could result in discharges to other media, while waste minimization practices may shift waste discharge locations. For example, wood preservers may be able to increase the amount of wood preservative that is absorbed in the wood itself, with less waste discharged at the plant site. The wood that is placed in the ground, however, can potentially leach more wood preservative into the ground than before. Thus, a high yield, low waste product may result in greater transmission of the toxic material to the environment via consumer use versus industrial discharge at the plant site.

Measuring and monitoring the results of this option could be very difficult. It may only be possible to document the instances in which these types of activities have taken place rather than to measure the effects of the procurement policy. For the first aspect of the option, agencies can track the amount of products purchased that contain recycled materials. The type and percent of recovered materials could be broken out on a per product basis and compared with the amounts of the same materials that are in each product prior to implementation of the procurement program. For the second aspect of the option, measurements could be made at the manufacturing plant. This poses problems in instances where plants may already have been enlisting waste minimization techniques prior to contracting with the purchasing agencies.

Other Issues

Inter-Agency Impacts:

Inter- and intra-Agency cooperation will be necessary to avoid problems in the implementation of this option. In the case of the second part of the option, there is the potential for cross media shifts between water and air. Coordination with the other program offices within EPA would help to minimize the shifts. Providing auditing guidance to DOD in assessing waste minimization programs at GOCOs or other facilities will also helpful.

Impacts on States: The first part of the option is most likely to work best if cooperation is encouraged with States whose bureaucracies allow a bit more flexibility in developing procurement strategies. It is also not likely to conflict with State waste minimization programs. In fact, it will probably complement existing programs.

Public Perception: The general public is not likely to find the option objectionable. If the program results in no increase in recycled materials or no waste minimization, then there may be some criticism of the program. In general, however, the public is not particularly attentive to the environmental aspects of products that government agencies purchase.

3.0 Recommendations

Although EPA could write procurement guidelines, its role would be better served as facilitator of procurement strategies for Federal agencies. Such strategies could also be coordinated with the procurement activities of State purchasing agencies. The difficulty of this role is that such activities have traditionally been downplayed within the Agency because of the problems involved in measuring results. In order for such an option to be accepted, the Agency would probably have to issue some type of procurement guideline. The ultimate success of such a program, however, is in convincing the various agencies to actually change their purchasing habits.

Procurement standards should be quite flexible and should encourage negotiation between manufacturers and purchasing agencies. DOD, for instance, could serve as a model for companies within the private sector, particularly where waste minimization cost savings are demonstrated.

This option appears to have the potential to change waste generation rates and should therefore be pursued. EPA also has the added advantage of existing legislative authority to implement it. The Agency will report on the status of these activities at a later date.

Appendix B

WASTE MINIMIZATION OPTIONS NOT CONSIDERED

Waste Minimization Options
Not Considered

Eight options that were listed in the Technical Support Document (TSD)[1] have not received further consideration in this Report To Congress for one or more of the following general reasons: (1) they did not further the goals of waste minimization as is defined in this Report to Congress, (2) they were not adequately developed in the Technical Support Document to pursue as a individual options, and/or (3) action to implement the particular option has already begun. The options excluded from analysis include:

- Establishment of toxicity levels for delisting petitions.
- Expedited delisting petitions.
- Improved waste marketing capability for hazardous wastes generated by the military services.
- Waste end tax.
- Developing certification standards for outstanding recycling facility performance.
- Reduced liability for generators if using specially permitted recyclers.
- Recycled Substances Act.
- Enforcement bounties.

Each is discussed in turn below.

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[1] Office of Solid Waste, February 17, 1986 Draft Final Report: Waste Minimization Issues and Options, volume 1, USEPA, Chapter eight.

Establishment of Toxicity Levels for Delisting Petitions

The establishment of toxicity levels was withdrawn as an option because of its relationship to expedited delisting petitions. Toxicity levels would determine the thresholds for delisting of wastes. Setting levels below which a waste would no longer be considered hazardous and thus subject to RCRA regulation, would not be a genuine waste minimization technique. Rather, it could be a technique to define away a class of wastes that were previously considered hazardous.

The extent to which such a modification in procedure might actually minimize hazardous waste generation would depend on whether the petitioner is encouraged to manage wastes such that they fall below the toxicity thresholds, and/or will apply a portion of the cost savings to waste minimization practices for the remaining hazardous wastes. The present case-by-case delisting approach has been adopted because hazardous wastes or hazardous constituents behave differently in different environments and in the presence of other wastes or constituents. Adopting a standard threshold might require setting a value at worst-case levels, which might result in having virtually no waste qualifying for delisting. Further, determining if a petitioner's waste qualified for delisting might still require time consuming case-by-case consideration. Given these constraints, setting toxicity levels for delisting is not a feasible waste minimization option.

Expedited Delisting Petitions

Expedited delisting petitions was eliminated as a candidate for option consideration because it would merely define away hazardous wastes. Currently, EPA allows a waste to be delisted for two reasons, neither of them constitute waste minimization. The first reason for delisting is if a waste does not meet the criteria that defines hazardous wastes. The second reason is if a listed hazardous waste is treated to the extent that is no longer meets the hazardous waste criteria (40 CFR 261).

Develop Improved Waste Marketing Capability for Hazardous Waste of the Military Services

The Department of Defense is embarking on several programs to expand its its marketing of hazardous wastes. This approach to waste minimization is, therefore, a current activity, and is no longer an option that requires further consideration.

Waste End Tax

A waste end tax has been proposed under the pending CERCLA reauthorization legislation. While the purpose of the amendment is to meet the funding needs for future clean up of abandoned hazardous waste sites, one indirect effect might be to encourage waste minimization. The present report therefore considers this option to be within the realm of existing activities.

Developing Certification Standards for Outstanding Recycling Facility Performance

EPA eliminated this as an option because it does not get involved in the development of standards. This would be the purview of ASTM.

Reduced Liability for Generators if Using Specially Permitted Recyclers

This option is not considered because, in the opinion of the Office of General Counsel, common law tort liability would remain unchanged. The option, therefore, would have little practical effect.

Recycled Substances Act

EPA believes it already has adequate authority to encourage recycling through RCRA, rendering a Recycled Substances Act largely superfluous. The existing mechanism is derived from the Definition and Exemption sections of EPA's regulations for identifying solid and hazardous wastes (§261.2—§261.4). The Agency could, perhaps, employ the same rationale they have already used for exempting certain chemicals because of their intrinsic value in a generator's production process. Chemicals such as pulping liquors and spent sulfuric acid are exempt from hazardous waste regulations since generators are unlikely to dispose of them as wastes. They, instead, continuously reclaim the chemicals for reuse in the production process rather than treating them as wastes for disposal. If, after study, EPA finds that a particular chemical such as toluene or acetone is normally reclaimed for reuse rather than disposed of by the generator, the Agency could use its authority to exempt that chemical from regulation. Regulation of these chemicals under these circumstances would be unnecessary as an incentive to encourage recycling since the chemical is typically reclaimed anyway. Such an approach would essentially accomplish the same purpose as legislation for recycled substances.

Enforcement Bounties

Third party participation in the enforcement of EPA regulations is an option that may have some beneficial effect on EPA's monitoring and enforcement responsibility. It is not, though, a direct means to achieve waste minimization. Several methods are currently in existence or have already been proposed to encourage citizen participation in the enforcement of EPA regulations. These include the setting up of telephone hot lines, initiation of citizen suits and the awarding of money for information leading to prosecution or punitive action against a violator.

Some States have begun developing telephone hot lines to encourage citizens to contact them should they have questions about waste generation regulations. State and federal telephone hot lines may also be used to anonymously report violators to the State regulatory agency.

Section 7002 of HSWA extended the power citizen suits for the enforcement of RCRA. It allows a citizen(s) to, "commence a civil action on his own behalf" against anyone including the government that is in violation of the RCRA. The costs of litigation are born by the citizen(s) taking action but the court may awards the costs of litigation to the, "substantially prevailing party, whenever the court determines such an award is appropriate."

Finally, an award system has been proposed in the reauthorization legislation for CERCLA. Awards for information are to be used where the information leads to the arrest and conviction of persons engaged in criminal hazardous waste activities.

Appendix C

HISTORY OF OSW WASTE MINIMIZATION

History of OSW Waste Minimization

1.0. Introduction

Beginning with the Solid Waste Disposal Act of 1965 and continuing to the promulgation of the Hazardous and Solid Waste Amendments of 1984 (HSWA), the U.S. Congress has directed the Federal Government, particularly the Environmental Protection Agency (EPA), to improve industrial and manufacturing systems of managing and disposing of hazardous waste. In this process, EPA's efforts have reflected three stages of development which have resulted in the current emphasis by the Office of Solid Waste (OSW) upon development of alternative methods to minimize the generation of hazardous waste. Over nearly 20 years of experimentation and innovation, EPA has begun to develop the requisite base of information on the magnitude and sources of the national hazardous waste problem, the institutional framework for managing the volume of waste generated, and the legal basis for encouraging aggressive development of new technological processes from the private sector.

Phase I: 1965-1976

The Solid Waste Disposal Act of 1965 (PL-98-272) established a modest research effort and technical assistance program for States and localities to improve management and conservation practices with respect to municipal waste.[1]

The Resource Recovery Act of 1970 mandated a national disposal site study and strengthened the programatic emphasis upon recycling of municipal and post-consumer wastes. Although the activities of the waste generators continued essentially unregulated during this initial phase, EPA and other organizations undertook research activities focused on solid waste recycling. These studies concluded the following:

- Recycling was technically possible;

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[1] Senate, July 25, 1984, *Congressional Record*, SB. 9149.

- Because the level of recycling was almost entirely dependent on economics, recycling as an effective alternative to land disposal would probably not occur until government specifications and legislation changed to encourage development of markets for recycled and reprocessed materials;
- Viable markets are essential to encourage industry to plan for recycling and reuse in the design of new products;[2]
- Air and water pollution regulations must be strengthened to support industrial incentives for reusing secondary materials.[3]

Phase II: 1976-83

Phase II was characterized by EPA efforts to essentially manage and control the symptoms of the hazardous waste problem. By 1977, EPA estimated that about 10 percent of industrial wastes generated may fall in the "hazardous waste" category. Industrial waste generation was growing at a rate of about 3 percent per year.. The generation of municipal solid waste (residential and commercial) refuse was also increasing.

The extent of the groundwater contamination problems related to improper disposal of hazardous waste was clarified by EPA through a survey and study implemented pursuant to Section 1442 (a) (4) of the Safe Water Drinking Act and reported to Congress in 1977. The study concluded: "Waste disposal practices have contaminated groundwater on a local basis in all parts of the nation and on a regional basis in many heavily populated and industrialized areas. Nationally, the principal sources of groundwater contamination related to waste disposal practices are industrial wastewater impoundments and solid waste land disposal sites."[4]

In response to growing evidence on the serious problem of groundwater contamination from hazardous wastes, the Resource Conservation and Recovery Act

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[2] Ann Tasseff, 1972, "Recycling Solid Waste, " *Environmental Reporter*, Volume 3, No. 13, Monograph 12, p. 26.

[3] Office of Solid Waste Management, 1974, *First Report to Congress: Resource Recovery and Source Reduction*, USEPA, Washington, D.C., p. ix.

[4] USEPA., 1978, "EPA Activities under RCRA of 1976" *Annual Report to the President and Congress*, FY 1977, USEPA, Washington, D.C., p.3.

(RCRA) provided a "cradle to grave" management system of hazardous waste generated from current industrial operations. Centered around Subtitle C, three distinct sets of standards and responsibilities were applied to hazardous waste generators, transporters, and owners and operators of disposal facilities. Concurrently, the Act established a program for comprehensive management planning for municipal waste and called for closure of open dumps.

Significantly, in 1976 EPA indicated the preferred future direction of hazardous waste management efforts with publication of a statement of "EPA Preferred Waste Management Strategies" The hierarchy of practices was the following:

1 Waste Reduction — reducing the amount of waste at the source through process change;

2 Waste Separation — isolating wastes from mixtures in which they occur;

3 Waste Exchange — transferring of wastes through clearinghouses;

4 Energy/ Materials Recovery — reusing and recycling wastes for original or some other purpose, such as for materials recovery or energy production;

5 Incineration/Treatment — destroying, detoxifying and neutralizing wastes to less harmful substances;

6 Secure Land Disposal — including volume reduction, encapsulation, leachate containment, monitoring, and controlled air and surface/subsurface water releases.

From 1981 to 1983, while the OSW activities centered around development of the regulations and guidance for generators, transporters, and owners/operators of hazardous waste disposal facilities, new evidence of the growing volume of hazardous waste brought increased Congressional concern toward the national program. The recent national generators survey indicated and increase in the production rate from 11 billion gallons or 400 million metric tons of hazardous waste produced annually dated in 1980. By August 1983, EPA increased this estimate to roughly 40 billion gallons, that is, to an annual generation rate of 1,500 million metric tons of hazardous waste each year. These estimates involved hazardous waste generators as well as treatment, storage, and disposal facilities regulated under RCRA in 1981. This national survey did not include mining wastes, some of which are hazardous, or household wastes such as discarded pesticides, paint thinners, and cleaning solvents. These waste estimates also excluded hazardous waste generated by individual businesses who produce less than 1,000 kilograms per month.[5] By 1984, EPA estimated that there were more that 71 billion gallons of hazardous waste generated in the U.S. every year. This is equivalent to 264 million metric tons.

Phase III: 1984-1986

Promulgation of HSWA implies a new phase in the development of the national hazardous waste management program by its new emphasis upon the cause of hazardous waste generation. HSWA encourages alternative production processes and raises the economic costs of relatively cheap land disposal.

HSWA adds new requirements that "the Administrator shall compile and submit to Congress a report on the feasibility of establishing standards of performance or taking other additional actions... and any recommendations for legislative changes to implement the newly added statement of national policy. "Wherever feasible, the generation of hazardous waste is to be reduced, or eliminated as expeditiously as possible. Waste that is nevertheless generated shall be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment"[6]

Generators of hazardous waste must now certify that they have a "program in place to reduce the volume or quantity and toxicity of such wastes to the degree determined by the generator to be economically practicable;" and that "the proposed method of generation, treatment, storage and disposal is that practicable method currently available to the generator which minimizes the present and future threat to human health and the environment."[7]

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[5] Senate, July 25, 1984, *Congressional Record*, SB. 9149.

[6] Section 1003 (b), Hazardous Solid Waste Amendments to the Resource Conservation and Recovery Act of 1976.

[7] Ibid., Amendment to Section 3002.

During Congressional debate on the amendments to RCRA proposed by the Senate, members indicated that "the need to minimize the volume and toxicity of all hazardous waste is clear and is made explicit national policy in this bill." [8] Senator Stafford, Chairman of the Committee, paid particular attention to the proposed amendments in Section 26 of HSWA. and argued that "At the Federal level, we must look for ways to encourage the development of alternative production processes, the substitution of less hazardous materials for more toxic ones, and other means to reduce both the quantity and toxicity of the wastes. We must also provide incentives for the development of treatment and disposal practices that minimize threats from the hazardous wastes that continue to be produced...Those changes will...emphasize waste reduction with the goal of eliminating disposal of hazardous wastes where they might in any way harm public health or the environment."[9]

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[8] Senate, Committee on Environment and Public Works, 1983 Solid Waste Disposal Act, 98-284, re. S. 757. p, 65.

[9] *Congressional Record*,, July 25, 1984, S.B. 9148

Appendix D

TOXICITY SCORING METHODOLOGY

Toxicity Scoring Methodology

Introduction

The HSWA's language promulgating the national policy favoring waste minimization refers to the need to reduce the "volume or quantity and toxicity" of hazardous wastes. In discussing this policy, the Senate report on the HSWA amendments refers to the "amount and toxicity" of wastes as targets for waste minimization. It states, for instance, that "the need to minimize the volume and toxicity of all hazardous waste is clear and is made an explicit national policy in this bill."[1] In discussing Section 3002 manifest certification requirements, the Senate report elaborates that certification indicates that a generator "has a program in place to reduce the volume or quantity and toxicity of hazardous waste...to the degree economically practicable...and that the practicable method currently available...minimizes the present and future threat to human health and the environment."[2]

While neither the Act nor the Senate report explicitly defines the concept of toxicity, the Senate report does imply that the concentration of toxic components in a waste affects its toxicity when it says that "[generators] may find that the reduction of waste volume would result in increased toxicity"[3]. By calling for simultaneous reductions in both volume and toxicity, Congress clearly wishes to avoid defining dewatering and other waste-concentrating processes as being valid types of waste minimization.[4]

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[1] U.S. Senate, Committee on Environment and Public Works, 1983, Solid Waste Disposal Act, re: Senate Bill 757, p.65.

[2] Ibid, p. 65.

[3] Ibid, p. 66.

This Appendix discusses the concept of toxicity as it applies to hazardous wastes and waste minimization. To be responsive to Congress's interest in using waste minimization to reduce waste toxicity, EPA has conducted a preliminary screening exercise to rank wastes in order of their toxicity and assign them to very general toxicity categories. Such an effort explores the following questions:

- What is the range of toxicities encountered among known hazardous wastes?
- How is toxicity of wastes distributed (i.e., what percentage of listed waste categories are high toxicity, medium toxicity, or low toxicity)?
- How is toxicity of waste correlated with volume?

The last question addresses Congress's concern that waste minimization not simply reduce waste volume at the expense of increasing its toxicity. The other questions are not explicitly brought up in the Act or the Senate report, but are of interest to EPA in defining appropriate targets for the Agency's waste minimization efforts.

General Approach to Scoring Toxicity

Although the concept of waste toxicity is intuitively meaningful, there is no generally acknowledged scientific approach to scoring toxicity in quantitative terms. Most toxicological studies can estimate relationships between a particular substance and health effects,[5] but such studies clearly specify (1) the context of the exposure in question, including such factors as route of ingestion, duration of exposure, and effective dose, as well as (2) the particular human health effect of concern (e.g., cancer, liver damage, neurological effects, etc.). Toxicological considerations become more complex because a hazardous waste may be a heterogeneous mixtures of many contaminants, each of which could potentially pose a risk of several different human health effects, and which may interact with other components in the waste to enhance or decrease the effective toxicity of specific components.

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[4] EPA agrees in principle with this policy. As stated in the main body of this report, however, the Agency believes that Congress did not intend this wording to disqualify volume reduction by itself (with no change in toxicity) as being legitimate waste minimization. For example, EPA considers it beneficial if a firm can change its processes to produce less waste per unit product, even if the composition of the waste does not change.

[5] Toxicological studies generally involve a mammalian animal species; results of such studies can be used to assess potential toxicity to humans. For chemicals for which epidemiological studies are available, the results can be directly applied usually with a high degree of confidence.

The approach used here is to create an aggregate score that combines information on constituent hazards, constituent fractions, and waste composition for each waste stream. While such scores have no toxicological meaning, such a scoring process does permit us to make intuitively logical distinctions among wastes. Highly dilute waste streams containing small amounts of materials with comparatively weak adverse health effects are strongly distinguished from highly concentrated streams made up of extremely hazardous materials (such as PCBs or dioxins). The actual equation used to develop the score is discussed below. Its key features are:

1. Consideration of all hazardous constituents: The score is developed using all available information on hazardous constituents (i.e., it is not based exclusively on the potency of, for instance, the most hazardous compound in the waste).
2. Consideration of mass fraction of hazardous compounds: Scores are weighted according to the combined concentration of all hazardous constituents known to be in the waste stream.
3. All health endpoints are considered: Rather than select for a single health effect (such as cancer), all health effects known to be associated with the constituents are included.[6]

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[6] Although a variety of health endpoints are considered, no attempt is made to adjust the score to take into account of effect thresholds that may be associated with a given health effect. This applies to most noncancer health impacts, but has no effect on scoring for carcinogens (see methodological discussion). Lack of consideration of thresholds is not expected to result in any significant impact on the toxicity score component obtained using the scoring approach. In addition, no attempt is made to weight the relative importance of health effects—all effects are given equal weight.

Precedents for Toxicity Scoring

Comparatively few efforts have been made in the past to create scores of this type. The most important in this context is the work done by the Office of Solid Waste to schedule prohibition determinations for waste streams listed in 40 CFR 261 into the required statutory "tiers" required by RCRA Section 3004.[7] This effort divided wastes into categories based on their toxicity and volume; it was intended to put wastes with high volumes and toxicities into the first priority category.

The toxicity scoring method used in this case was different from the current proposed method in two important ways. First, wastes were ranked based on the toxic potency of the most hazardous constituent in the waste, rather than the toxic potencies of all known hazardous constituents. Second, the method did not take account of the mass fraction (concentration) of the constituent; therefore, dilute wastes and concentrated wastes containing the same constituent were ranked identically as to toxicity. This method was, however, appropriate to the task at hand only because the wastes in question were frequently single-constituent wastes that were often highly concentrated. Specifically, they included many of the U and P classified RCRA streams, which include off-specification chemicals and spills.

For the current exercise it was determined that it is highly important to weight scores by mass fraction because (1) of Congressional concern that waste minimization goals not be circumvented by dilution or concentration of wastes, and (2) all classes of wastes are of concern (including solvent and dioxin wastes, the "California list" wastes, as well as the scheduled "tiered" wastes). To ensure as much consistency as possible with this scoring effort, however, the toxicity score components of the overall scores for individual waste constituents developed by this previous project were used here; gaps were filled as necessary using the same methodology (see below).

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[7] Office of Solid Waste, March 28, 1985, "Documentation for the Development of Toxicity and Volume Scores for the purpose of scheduling Hazardous Wastes," USEPA.

Limitations of the Approach

There are a number of critical limitations in the toxicity scoring approach used here, some of which are discussed at greater length below. Results must therefore be interpreted accordingly. The principal caveats are:

- Quality of data on waste streams: Existing data characterizing the identity and mass fraction of hazardous constituents within waste streams is highly uncertain and preliminary. This effort was based on the comprehensive information developed for the RCRA Risk/Cost Analysis Model, since that data base is the most complete and comprehensive currently available.

- Synergisms among health effects are disregarded: The toxic effects of multiple toxic compounds in a mixture may be higher or lower than the effects of exposure to the same compounds separately. Data are not available to make any statement about such joint effects; they are typically disregarded in standard toxicological practice.

- Scores for different health effects are added together: The score adds together different categories of health effects into a single score, without weighting.[8]

- Uncertainties in health effects data: The health effects data on which scores were developed contain inherent unquantifiable uncertainties. The impact of these uncertainties is that the actual toxicities of the individual components may be higher or lower than those presented in this report. Furthermore, health effects data on some chemicals are extremely limited or incomplete; thus, future toxicological research may generate more comprehensive data that would result in different toxicity scores.

Despite these limitations, the Agency believes that the results of this scoring exercise are useful in comparing basic patterns of variations among waste streams.

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[8] Efforts have been made elsewhere in EPA to assign relative weights to health effects based on such considerations as pain and suffering, wages lost, years of life lost, the reversibility or irreversibility of an effect, and costs of treatment. One example was the scoring approach developed in 1981 by Dr. Milton Weinstein of the Harvard School of Public Health for the Integrated Environmental Management Program in the Office of Policy Analysis.

Methodology for Toxicity Scoring

The toxicological significance of a given waste stream is defined in this report as being proportional to the sum of the products of the toxicity ranking factor (T) and the concentration ranking factor (C) over the n constituents in the waste stream, or:

$$\text{overall ranking of waste stream} = \sum_{i=1}^{n} (T_i \bullet C_i)$$

The range of the overall rankings for all the waste streams is then condensed by taking the $\log_{10}$ of these values and distributing the resulting values into ten classes. The toxicities of the individual waste stream components are ranked in this system based on an effective dose equivalent (EDE) calculated using unit risk values, unit risks calculated for noncancer effects, and other toxicological benchmarks for chronic effects and acute toxicity data.

Method for Developing Toxic Potential Scores

The report that scheduled hazardous wastes calculated the toxic potential of 363 hazardous waste constituents listed in Appendix VII of 40 CFR 261. It gave consideration to both acute and chronic forms of toxicity and assigned a value representing toxicity potential to each constituent regardless of the data base available to the constituent. The constituents were ranked according to their toxic potential, but because of the assumptions that they had to make the authors of the report considered it imprudent to use the ranking scheme, "...for purposes other than relative comparison of the inherent toxic potential of waste constituents."[9]

Scoring Acute Toxicity: Acute toxicity represents the inherent short term hazard potential of a chemical. It is generally expressed as the minimum quantity of a toxicant necessary to be lethal to 50 percent of a test population based on a single exposure typically measured over a 96 hour period. Chemicals vary in their acute toxicities. Some may be lethal in small doses while others that are not very potent are lethal only in large doses. LD_{50}'s are usually derived from oral or dermal exposure; however, the counterpart for inhalation does exist as the lethal concentration at which fifty percent of the tested population is killed (LC_{50}). In cases where LD_{50} or LC_{50} have not been calculated the report relies on an LD_{lo} (lowest dose causing death). When this is unavailable for a particular chemical the report relies on acute data from structurally similar chemicals.

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[9] Office of Solid Waste, March 28, 1985. *Documentation for the Development of Toxicity and Volume Scores for the Purpose of Scheduling Hazardous Wastes*, USEPA; pp. 5.

Under normal circumstances exposure to a fatal *single* dose of a chemical from environmental sources is rare. Human populations normally experience long term, intermittent, repeated, or continuous exposures at concentrations that are well below those associated with acute toxicity. The methodology in this report takes into account typical real world exposures to chemicals by assigning acute toxicity the highest score of one only in those few instances where exposure to chemical compounds even at low levels is very hazardous (i.e., for highly acutely toxic chemicals with LD_{50}'s less than 50 mg/kg body weight).[10] Most chemicals received an acute toxicity score of zero (i.e., no acute toxic effect on the population at expected environmental levels signifying a low acute toxicity.

Scoring Chronic Toxicity: Unlike acute toxicity, chronic toxicity refers to adverse impacts of exposure to a chemical experienced over a long period of time (years to an entire lifetime). An Effective Dose Equivalent (EDE) standardizes chronic toxicity in order to make comparisons between chemicals. EDE is defined as the dose at which the, "...estimated risk associated with a compound is comparable among all compounds being evaluated."[11] Several calculations are necessary for determining EDEs. For a given noncarcinogen, either an acceptable daily intake (ADI), a no observed effects level (NOEL), or a unit risk is used as a basis for determining the EDE. A unit carcinogenic risk (UCR) value is applied for calculating EDE values for carcinogenic compounds.

Values for the UCR are based on the probability of a chemical causing cancer over a life time of 70 years at a relatively low dose exposure(1 mg/kg body weight/day). The UCR represents the upper bound of risk, referred to statistically as the upper 95 percent confidence limit, which means that in 95 percent of cases, the true risk to an individual will be equal to or less than the UCR. The risk value, which is related to the expected incidence of cancer at this low dose, becomes the slope of the dose-response curve; this curve is assumed to be linear at these low doses. Furthermore, for carcinogenic effects, it is assumed that there is no no-effect threshold; that is, carcinogens will exhibit some nonzero risk at each dosage level regardless of how small.

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[10] The report used the same cutoff value cited in 40 CFR 261.11(a)(2) which delineated acute hazardous wastes from toxic waste.

[11] Ibid. p. 9.

In order to make carcinogens comparable with noncarcinogens an adjustment is necessary to develop an EDE. A standardization factor of 10^{-6} (risk of of a toxic effect occurring in 1 in 1,000,000 population) is used for both carcinogens and noncarcinogens. The conversion into standardized values represents uniform risk levels for carcinogens and noncarcinogens.

$$\text{EDE}_{\text{carcinogen}} = \frac{\text{Standardization Factor}}{\text{UCR}}$$

The ADI is the basis of noncarcinogenic EDE. It is defined as that quantity of a chemical measured by mg/kg body weight/day that is not expected to have an effect on the general population.[12] An ADI is calculated by dividing a no observed effect level (NOEL) with an uncertainty factor. The NOEL represents the highest dose level which does not have an effect on the test population. Where a NOEL is unavailable for a chemical in question other methods and additional uncertainty factors are used to determine an ADI. The uncertainty factors take into account level of confidence in the supporting study, the transposition of animal test data to the expected effect on the human population, etc.[13]

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[12] USEPA, 1980. Water Quality Criteria Documents: Availability. *Appendix C - Guidelines and Methodology Used in the Preparation of Health Effect Assessment Chapters of the Consent Decree Water Criteria Documents.*

[13] The uncertainty factor selected depends on the type of study conducted to determine ADI and is usually a factor of 10, 100, or 1000. The lowest uncertainty factor of 10 is used where the NOEL is based on chronic human data. This factor is meant to account for individual variability. 100 is used where the NOEL is based on animal studies and it accounts for both inter- and intra-species variation. The final number, 1000, is used where the NOEL is based on subchronic animal data and takes into consideration the uncertainty of extrapolating from subchronic to chronic exposures as well as accounting for the two previous uncertainty factors.

Not all chemicals have a NOEL value available. In cases where a NOEL is not available a LOEL or lowest observed effect level is used. In instances where subchronic and chronic data are unavailable, the EDE is calculated by taking the EDE value of a structurally similar chemical, or by using the chemical's known acute toxicity.

In all cases, a standardization factor must be used to convert the ADI values and acute toxicity values when NOEL or LOEL are not available into EDEs. For the NOEL the the formula is relatively straight forward. It is the division of the NOEL by the standardization factor of 10^{-6}:

$$\text{EDE}_{\text{noncarcinogen}} = \frac{\text{NOEL}}{\text{Standardization Factor}}$$

For LOELs, a severity factor is applied in addition to the standardization factor. The severity factor corrects for the type of observed effect. A lower number is selected if the observed effect is considered reversible (2.14), a mid-range number is selected (4.68) where there is increasing severity of the observed effect (e.g., organ necrosis, neurological effects, reproductive dysfunction or teratogenic effects). Finally, for chemicals using only acute toxic data, the EDE is calculated by dividing the acute toxicity value by 100,000 or 50,000 if the LD_{50} is based on an injection study.

Toxicity Ranking

Once EDEs are calculated for all the chemicals of concern, a ranking scheme is created to allow comparisons of the chromic toxicities of individual chemicals. The raw EDE values vary by 10 orders of magnitude or a 10 billion fold difference between the highest and lowest EDE. A 1 to 9 scoring based on the 10 orders of magnitude is calculated in order to express the differences in the toxicity of the chemicals. Table D-1 shows the boundaries for each of these categories.

Table D-1
Chronic Toxicity Scoring

Equivalent Dose Estimate EDE	Score
$\leq 10^{-7}$	9
$\geq 10^{-7}$ to 10^{-6}	8
$\geq 10^{-6}$ to 10^{-5}	7
$\geq 10^{-5}$ to 10^{-4}	6
$\geq 10^{-4}$ to 10^{-3}	5
$\geq 10^{-3}$ to 10^{-2}	4
$\geq 10^{-2}$ to 10^{-1}	3
$\geq 10^{-1}$ to 1	2
≥ 1	1

The acute toxicity scores of 1 or 0 are then added to the chronic EDE scores to calculate the total toxicity score for each of the chemicals. Of the 363 chemicals examined 140 (39 percent) have acute toxicity scores of 1.

Uncertainties in the Toxicity Potential Scoring

There are a number of limitations regarding this scoring methodology and the approach to ranking taken by this report. The scores themselves have no intrinsic value but are only used as an expression of the relative differences among the chemical compounds.

There is a limitation with creating an EDE from incomplete and/or nonequivalent data. The report notes that many of the 363 chemicals were poorly studied.[14] Twenty percent of the chemicals only have data on the acute effects of single exposure to the chemical. The frequent lack of a NOEL or other chronic data means that this report has had to rely on other data sources which in some instances are associated with a lower degree of confidence.

Most of the data are derived from animal studies, requiring extrapolations to estimate impacts on the general population. Interspecies extrapolation, while challenging, can be accomplished by such methods as accounting for metabolic rate differences, and by using surface area/body weight correction factors. Results from animal studies are often generated from doses that are much higher than what the general human population would normally experience. Probabilistic models are therefore used to generate dose-response curves that extrapolate from the higher experimental dose levels to the lower doses experienced by human populations from environmental sources. There are certain inherent limitations with high to low dose extrapolations. It is sometimes difficult to accurately predict what will be the impact on the human population due to factors that cannot be detected in high dose animal testing.[15] There are uncertainties about the synergistic effects. The studies assume independence of the chemicals and therefore do not take account of the impact of the combined effect they have on the human population.

Further uncertainties arise in that the scoring system attempts to compare chemicals that have qualitatively different toxic effects on the human population.

Furthermore, the scoring of a waste stream is based on single chemical compound. While a particular waste stream may have several constituents, the method selects the most hazardous constituent as a proxy to characterize the relative hazardousness of the whole waste stream.

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[14] Office of Solid Waste, March 28, 1985. *Documentation for the Development of Toxicity and Volume Scores for the Purpose of Scheduling Hazardous Wastes*, USEPA; pp. 6-7.

[15] Charles C. Brown, 1984. "High— to Low—Dose extrapolation in Animals," in, *Assessment and Management of Chemical Risks*, American Chemical Society, Washington, D.C., pp. 57-79.

Calculating Toxicity Potential Scores for Wastes Not Listed in the Scheduling of Hazardous Waste Report

There were 34 constituents for which toxic potential toxicity scores did not exist in the report on scheduling hazardous wastes. Scores were calculated for these hazardous waste constituents using the same methodology as employed in the scheduling report. Table D-2 displays the constituents, their potential toxicity scores and the sources for the data used in the calculations.

Methodology for Determining Mass Fractions of the Chemicals

The RCRA Risk-Cost Analysis Model gathered data on hazardous waste streams. The methodology involved measuring the concentrations of the constituents that made up a particular waste stream. The model gathered data on 154 waste streams which accounted for an annual generation of about 158 million metric tons.[16] The wastes investigated were primarily those considered hazardous under Subtitle C of RCRA (F and K wastes listed in 40 CFR 261). EP wastes were taken from Appendix VIII to 40 CFR 161. The model did not consider P and U wastes. The absence of P and U wastes, however, did not obstruct our toxicity analysis since they were typically single constituent highly concentrated wastes. Some of these streams were almost 100 percent of the chemical of concern (i.e., had a mass fraction of one); at such high concentration levels the toxicity scores from the Environ, Inc. report were considered accurate.

The risk-cost model also identified the industries that generated the waste streams in order to be able to make intra- and inter-industrial comparisons. By linking wastes with generators it was possible to identify which industries were generating the most and least toxic as well as the most and least voluminous hazardous wastes.

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[16] Data sources for the risk-cost analysis model came from EPA industry studies, permit applications, delisting petitions, state data, and trade associations. For further explanation see: Office of Solid Waste, March 1984. *The RCRA Risk-Cost Analysis Model*, USEPA.

Determining the Overall Toxicity Score for Each Constituent

An overall toxicity score is calculated by multiplying the toxic potential score and the mass fraction. The raw values range by ten orders of magnitude from the most to the least hazardous constituent.

Several alternative methods are used to determine toxicity categories. Since our main objective is to show relative differences between groups of waste streams rather than absolute differences between individual waste streams, it does not seem relevant to classify constituents by their raw values. If raw values are the basis of the categories, there would have been a clustering of a few waste streams at the highest toxicity category and the major portion of the streams at the low end of the spectrum. In the middle there would be gaps with very few or no waste streams. By taking a $\log_{10}$ of the toxicity scores it is possible to distribute the waste streams in such a fashion that relative toxicity could be compared by group classes. The problem with the $\log_{10}$, however, is the fact that while it softens the impact of a relatively few highly toxic constituents, it leaves the impression that there is not as great a difference between the high and low toxicity scores as there would have been had the raw scores been kept. It is considered worth the minor sacrifice in accuracy by using the $\log_{10}$ in order to be able to make some general observations about toxicity of hazardous waste streams and there relationship to the volume of waste generated.

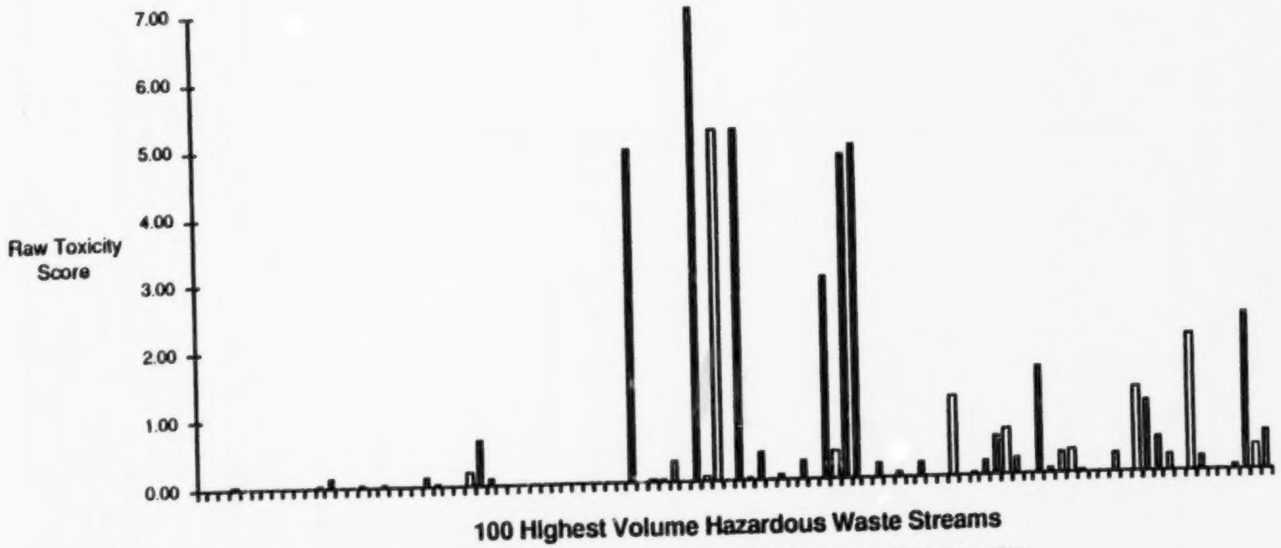
General Observations

Several generalizations can be deduced from the overall toxicity scores and the ranking classification. First, the purpose of this exercise has been to weight the potential toxic scores according to the constituent's mass fraction. Such an approach provides a relatively accurate picture of the toxicity of waste streams and their potential hazard to the human population. It is possible that a constituent with a high potential toxicity can have a low overall toxicity score and low rank if the concentration of the constituent in the waste stream is low. The converse is also possible — a constituent of relatively low toxic potential might very well have a high concentration and, therefore, a high overall toxicity score. What this implies is that the hazardousness of exposure to a waste stream is dependent not only on the toxic potential of the waste but also the concentration in which it might exist in the waste stream itself.

Second, the ten toxicity categories provides a way to make relative comparisons between groups of waste streams. The uncertainties of the methodology for determining the potential toxicity score weakens the ability to make comparisons between constituents based on their absolute differences. This methodology works best for grouping the constituents with similar toxicity scores and comparing relative differences between waste streams.

Toxicity scores could be useful in the general comparison of toxicity and waste stream volume. Volumes of waste streams were calculated from the mail survey of hazardous waste generators, and like the toxicity scores the volumes were classified into ten categories in descending order of volume after determining the $\log_{10}$ of the raw volume scores. With these two scores it was possible to contrast a constituent's toxicity and volume. Table D-3 displays these scores. There appears to be a weak inverse correlation between toxicity and volume of a waste stream, but in some cases there are highly toxic constituents appearing in very low volume, and in others there are low volume wastes that are highly toxic. Figure D-1 graphically depicts the relationship in Table D-3 for 100 of the highest volume wastes. It is apparent that the most voluminous streams are not the most toxic. In fact, it is at the middle and lower end of the volume spectrum that one finds the highest toxic streams. For select industries waste streams do exhibit a correlation between toxicity and volume. In Table D-4 three industries and their waste streams are listed by toxicity and volume. There is a tendency for the waste streams in these industries to be inversely correlated between volume and toxicity.

Figure D-1
Hazardous Waste Stream Toxicity Scores: Descending Order of Waste Stream Volume



Source: Using data from the RCRA Risk-Cost Data Base, with the EPA toxicity ranking developed for the land disposal restriction program schedule.

Table D-2
Toxicity Potential Scores For Missing Data

Hazardous Waste Constituent	Acute Score	Chronic Score	Total Toxicity Potential Score
1,1, Dichloroethane °°	0^	8	8
1,1,1—Trichloroethane °°	0*	4	4
1,2,4, Trichloroethane °°	0^	5	5
1,3, Dinitrobenzene °°	0*	6	6
1,4—Naphthoquinone °°	0*	6	6
2,3,7,8, TCDD °	1*	9	10
2,4—D*	0	4	4
2—Chlorophenol °°	0^^	5	5
Acenaphthene °°	0*	9	9
Barium °°	0†	6	6
Benzalkonium Chloride*	0	4	4
Benzo (K) Fluoranthene °	0	9	9
Beta—Hexachlorocyclohexane °	0*	8	8
Bis(2,3,3,3 - Tetrapropyl) Either**	0*	3	3
Cobalt**	0*	5	5
Copper °°	0*	8	8
Cyanide °°	1*	6	7
Di-N-Butyl Phthalate**	0*	3	3
Dibenzo (a,h) Anthracene °	0*	3	3
Dichloroethane °	0*	6	6
Dichloromethane °	0^	6	6
Dimethyl Alkylamine °°	0*	4	4
Epichlorohydrin °	1^	5	6
Fluorides °°	0^	9	9
Gamma—Hexachlorocyclohexane °	0*	9	9
Hydroquinone °°	0^^	6	6
PCB—1254 °°	0*	9	9
Pentachlorophenol °°	1^	5	6
Phorate °°	1^	9	10
Pyrene °	0*	9	9
Toxaphene °	1*	8	9
Trichlorobenzene °°	0*	5	5
Vanadium °°	0*	6	6
Zinc °°	0*	3	3

*Tatken, R.L.; R.J. Levine (eds.), 1983, Registry of Toxic Effects of Chemical Substances, Volumes 1,2,3; National Institute for Occupational Safety and Health; Cincinnati, Ohio.

**Office of Solid Waste, 1986, "Documentation for W-E-T Model Impact Parameters"; March, 1986.

°Office of Health and Environmental Assessment,1985, Health Assessment Document For Nickel; USEPA—600/8-83/012F. pp. 8—199 to 8-202.

°°ICF, Inc. 1984, The RCRA Risk—Cost Analysis Model; ICF, Inc., Washington, D.C.

^ Verschverens, K., 1983, Handbook on Environmental Data on Organic Chemicals; Van Nostrand, Reinhold Co., NY.

^^ USEPA, 1979, Multimedia Environmental Goals for Environmental Assessments; Volumes III & IV, USEPA 600/7-79-176 A&B.

†USEPA, 1980, Ambient Water Quality Criteria Documents; USEPA 440/5-80, Series.

Table D-3
Toxicity and Volume scorces of RCRA Listed Wastes

SIC Code	RCRA Code	Toxicity Score	Toxicity Group*	Volume (kkg/yr)	Volume Group*
2819	P063	7.0000	1	55,831	3
2869	Characteristic	5.5560	1	960	6
2869	K030	5.2100	1	48,400	4
2869	K020	5.1990	1	52,700	4
2869	K018	4.9500	1	35,400	4
2869	K019	4.9340	1	80,300	3
2865	K083	4.8910	1	1,800	5
2812	K073	4.8850	1	340	6
2869	K095	4.8050	1	35,500	4
2869	K096	4.7440	1	3,200	5
2869	K029	4.1700	1	1,300	5
2869	K021	4.0020	1	270	6
2879	K042	3.5000	1	6	8
721	F002	3.0000	1	38,040	4
2869	Characteristic	2.7060	2	2,700	5
2869	K016	2.4850	2	1,600	5
2865	K025	2.4520	2	1,500	5
2869	K017	2.3200	2	6,360	5
2879	K043	2.3000	2	4,990	5
2869	Characteristic	2.2740	2	1,400	5
2869	Characteristic	2.0400	2	8,200	4
2851	F005	1.8000	2	3,070	5
2865	K085	1.7000	2	4,500	5
2869	Characteristic	1.6080	2	2,600	5
2865	Characteristic	1.6000	2	17,300	4
2879	F002	1.5000	2	1,230	5
2833	K084	1.4400	2	500	6
721	F002	1.2500	2	9,510	4
2879	K034	1.2350	2	170	6
2851	F005	1.2000	2	5,430	5
2819	P120	1.2000	2	1,842	5
2869	K010	1.1990	2	26,300	4
2869	Characteristic	1.1520	2	140	6
2869	Characteristic	1.0800	2	9,100	4
2865	K023	1.0000	2	760	6
2865	K093	1.0000	2	2,100	5
2869	P016	1.0000	2	72	7
2819	P011	0.9000	2	10	8
2819	P012	0.9000	2	140	6
2879	P059	0.9000	2	44	7
2869	K026	0.8500	2	1,440	5
2879	U036	0.8000	2	150	6
2869	U078	0.8000	2	0	0
2865	K015	0.7470	2	680	6
2865	Characteristic	0.7000	2	22,700	4

Table D–3: Continued

Toxicity and Volume scorces of RCRA Listed Wastes

SIC Code	RCRA Code	Toxicity Score	Toxicity Group*	Volume (kkg/yr)	Volume Group*
2819	P021	0.7000	2	25	7
2819	P029	0.7000	2	151,222	3
2819	P074	0.7000	2	2	9
2819	P098	0.7000	2	6	8
2819	P104	0.7000	2	0	0
2819	P106	0.7000	2	637	6
2819	P121	0.7000	2	10	8
2865	U023	0.7000	2	58	7
2865	U127	0.7000	2	201	6
2851	F005	0.6000	2	580	6
2819	P113	0.6000	2	82	7
2819	P115	0.6000	2	6,083	5
2869	U080	0.6000	2	24,094	4
2869	U209	0.6000	2	1,930	5
2869	U211	0.6000	2	108	7
2819	U214	0.6000	2	1,231	5
2819	U215	0.6000	2	1,231	5
2819	U216	0.6000	2	82	7
2819	U217	0.6000	2	656	6
2865	U242	0.6000	2	58	7
2992	Characteristic	0.5300	2	9,000	4
2819	U032	0.5000	2	24	7
2869	U043	0.5000	2	243	6
2869	U044	0.5000	2	318	6
2869	U077	0.5000	2	2	9
2869	U128	0.5000	2	193	6
2869	U131	0.5000	2	96	7
2819	U151	0.5000	2	219	6
2869	U208	0.5000	2	193	6
2869	U227	0.5000	2	11	8
2869	U228	0.5000	2	155	6
2865	U231	0.5000	2	0	0
2865	K094	0.4450	2	700	6
2869	Characteristic	0.4400	2	43,650	4
2491	K001	0.4356	2	35,700	4
3333	Characteristic	0.4306	2	500	6
285	F005	0.4000	2	1,030	5
2879	K036	0.4000	2	130	6
2869	Characteristic	0.4000	2	820	6
2869	Characteristic	0.4000	2	40	7
2869	U084	0.4000	2	169	6
2819	U144	0.4000	2	1	9
2819	U145	0.4000	2	1	9
2819	U146	0.4000	2	0	0
262	U226	0.4000	2	6,117	5

Table D-3: Continued

Toxicity and Volume scorces of RCRA Listed Wastes

SIC Code	RCRA Code	Toxicity Score	Toxicity Group*	Volume (kkg/yr)	Volume Group*
2865	K024	0.3600	2	2,500	5
2865	K103	0.3485	2	15,150	4
2992	Characteristic	0.3400	2	69,000	3
2869	Characteristic	0.3160	2	15,500	4
3312	K087	0.3034	2	39,800	4
2865	P028	0.3000	2	201	6
2865	U037	0.3000	2	2,586	5
2865	U070	0.3000	2	20	7
2869	U083	0.3000	2	95	7
3333	Characteristic	0.2808	3	11,000	4
2869	Characteristic	0.2700	3	22,700	4
2865	K015	0.2520	3	8,380	4
2869	P023	0.2500	3	169	6
2879	Characteristic	0.2400	3	500	6
3351	Characteristic	0.2400	3	8,000	4
2491	Characteristic	0.2390	3	25,100	4
3341	K069	0.2324	3	28,600	4
3341	Characteristic	0.2272	3	153,300	3
2992	Characteristic	0.2200	3	32,000	4
2869	Characteristic	0.2000	3	5,800	5
2869	U045	0.2000	3	650	6
2865	U072	0.2000	3	16	8
2869	U081	0.2000	3	649	6
2869	U082	0.2000	3	169	6
2892	K045	0.1825	3	242	6
2865	Characteristic	0.1750	3	187,000	3
2865	Characteristic	0.1740	3	5,600	5
2821	Characteristic	0.1600	3	486,000	2
2869	Characteristic	0.1570	3	1,600	5
2879	Characteristic	0.1500	3	500	6
3691	Characteristic	0.1400	3	150,000	3
3692	Characteristic	0.1300	3	1,300	5
2851	Characteristic	0.1255	3	500	6
3398	F012	0.1232	3	190	6
2869	Characteristic	0.1230	3	3,600	5
2812	K106	0.1050	3	7,000	5
3333	Characteristic	0.1046	3	16,000	4
3332	Characteristic	0.1025	3	42,000	4
2865	Characteristic	0.1010	3	30,000	4
2821	Characteristic	0.1000	3	53,000	4
2869	K028	0.0905	3	610	6
2879	K041	0.0900	3	5,000	5
2869	Characteristic	0.0780	3	45,400	4
3312	K060	0.0737	3	72,000	3
2869	Characteristic	0.0706	3	172,500	3

Table D–3: Continued

Toxicity and Volume scorces of RCRA Listed Wastes

SIC Code	RCRA Code	Toxicity Score	Toxicity Group*	Volume (kkg/yr)	Volume Group*
2879	K097	0.0682	3	2,300	5
3471	F006	0.0624	3	488,400	2
2869	Characteristic	0.0600	4	291,500	3
2869	Characteristic	0.0600	4	2,720	5
2869	Characteristic	0.0600	4	4,500	5
2879	K031	0.0569	4	12,980	4
2879	K035	0.0560	4	3,130	5
2869	Characteristic	0.0520	4	8,172,000	1
2812	Characteristic	0.0500	4	25,900	4
2865	K104	0.0492	4	332,070	3
3312	K061	0.0478	4	70,000	3
2865	K022	0.0450	4	106,200	3
3312	K062	0.0425	4	2,950,000	2
2865	Characteristic	0.0420	4	136,200	3
2869	K011	0.0418	4	3,181,000	1
3320	Characteristic	0.0407	4	2,139,100	2
2865	Characteristic	0.0400	4	388,000	3
286	U240	0.0400	4	43,500	4
2869	Characteristic	0.0390	4	5,448,000	1
3000	Characteristic	0.0385	4	52,000	4
2879	K032	0.0350	4	160	6
3331	Characteristic	0.0341	4	640,000	2
2869	Characteristic	0.0279	4	101,700	3
2865	Characteristic	0.0260	4	118,000	3
2879	K040	0.0259	4	150	6
2816	K002	0.0249	4	27,000	4
2869	K009	0.0240	4	399,500	3
3313	Characteristic	0.0206	4	85,400	3
2861	Characteristic	0.0203	4	28,400	4
2892	K044	0.0200	4	1,700	5
2865	Characteristic	0.0200	4	12,500	4
2865	K105	0.0117	5	520	6
2865	Characteristic	0.0099	5	90,800	3
3313	Characteristic	0.0092	5	72,200	3
2869	Characteristic	0.0090	5	3,630	5
3471	F007	0.0089	5	1,990	5
2911	K050	0.0073	5	1,700	5
2823	Characteristic	0.0053	5	160,000	3
2861	Characteristic	0.0044	5	11,500	4
3313	Characteristic	0.0043	5	32,800	4
2893	K086	0.0040	5	10,000	4
2879	K037	0.0026	6	50	7
3313	Characteristic	0.0024	6	83,600	3
2879	K033	0.0020	6	8,280	4
2812	K071	0.0020	6	39,000	4

Table D–3: Continued

Toxicity and Volume scorces
of RCRA Listed Wastes

SIC Code	RCRA Code	Toxicity Score	Toxicity Group*	Volume (kkg/yr)	Volume Group*
2869	Characteristic	0.0017	6	190,600	3
3312	Characteristic	0.0015	6	60,000	3
2911	K048	0.0014	6	297,600	3
2869	Characteristic	0.0010	6	2,100	5
3341	K100	0.0008	6	139,500	3
2892	Characteristic	0.0007	6	24,000,000	1
2892	K047	0.0007	6	81,600	3
2911	K049	0.0007	6	92,400	3
3471	Characteristic	0.0005	7	17,300,000	1
2879	K038	0.0005	7	7,280	5
3312	Characteristic	0.0004	7	30,000	4
2879	K099	0.0004	7	26,180	4
3471	Characteristic	0.0004	7	30,700	4
2911	K051	0.0003	7	196,200	3
2869	Characteristic	0.0003	7	1,398,300	2
2911	Characteristic	0.0003	7	40,300	4
2911	K052	0.0003	7	7,100	5
3320	Characteristic	0.0002	7	16,915,102	1
2861	Characteristic	0.0002	7	96,200	3
2911	Characteristic	0.0001	8	20,600	4
2816	Characteristic	0.0001	8	742,100	2
2865	K027	0.0000	8	107,900	3
2911	Characteristic	0.0000	8	154,700	3
2911	Characteristic	0.0000	8	263,900	3
2911	Characteristic	0.0000	9	1,000	5
2879	K039	0.0000	10	355	6

* 1= high toxicity and Volume, 10= low toxicity and volume

Table D-4
Comparison of Waste Streams for Three Industry Categories

Industrial Sectors	RCRA Code	Toxicity Rank*	Volume Rank*
Industrial Organic Chemicals (NEC)	K030	1	4
	K020	1	4
	K018	1	4
	K019	1	3
	K095	1	4
	K096	1	5
	K029	1	5
	K021	1	6
	K016	2	5
	K017	2	5
	K010	2	4
	P016	2	7
	K026	2	5
	U078	2	0
	U080	2	4
	U209	2	5
	U211	2	7
	U044	2	6
	U043	2	6
	U208	2	6
	U128	2	6
	U228	2	6
	U131	2	7
	U227	2	8
	U077	2	9
	U084	2	6
	U083	2	7
	P023	3	6
	U045	3	6
	U081	3	6
	U082	3	6
	K028	3	6
	K011	4	1
	K009	4	3
Pesticides and Agricultural Chemicals	K042	1	8
	K043	2	5
	F002	2	5
	K034	2	6
	P059	2	7
	U036	2	6
	K036	2	6
	K041	3	5
	K097	3	5
	K031	4	4
	K035	4	5
	K032	4	6
	K040	4	6
	K037	6	7
	K033	6	4
	K038	7	5
	K099	7	4
	K039	10	6
Petroleum Refining	K050	5	5
	K048	6	3
	K049	6	3
	K051	7	3
	K052	7	5

* Ranking: 1 = high, 10 = low

Appendix E

WASTE MINIMIZATION CORRESPONDENCE AND BRIEFINGS

APPENDIX E

Waste Minimization Correspondence and Briefings

Introduction

This appendix contains examples of correspondence from members of the regulated community and other parties requesting clarification of specific aspects of the waste minimization provisions of HSWA. These inquiries were received by the Office of Solid Waste during 1985 and 1986. Appendix E also contains the OSW's response to specific inquiries as well as the text of briefing material on waste minimization prepared for the American Management Association.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 1 · 1985

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Mr. William Stough
Director
Great Lakes Regional Waste Exchange
3250 Townsend N.E.
Grand Rapids, Michigan 49505

Dear Mr. Stough

It was a pleasure to hear from you and learn of your interest in using waste exchange programs to support the waste minimization concept of the Resource Conservation and Recovery Act (RCRA) Reauthorization.

Where participation in a waste exchange program affects a generator's efforts to reduce the volume or toxicity of hazardous waste, such participation may be used to satisfy Section 3002(b)(1) of RCRA. Participation in a waste exchange program could also be used as evidence of compliance with §3002(b)(2), which requires that the generator select the method of treatment, storage or disposal which minimizes the threat to human health and the environment.

It is our hope that each year greater volumes of hazardous waste will be recycled, reclaimed and reused through waste exchange programs. Achievement of this goal will go a long way toward meeting the intent of Congress regarding the disposal of hazardous waste in or on the land.

We appreciate hearing from you. If you have further questions, please let me know.

Sincerely yours,

Michael Bloch

for John H. Skinner
Director
Office of Solid Waste (WH-562)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Fyi

JUL 11 1985

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Mr. R. R. Saulsman, Manager
Energy & Environmental Affairs
The Boeing Company
P. O. Box 3707
Seattle, Washington 98124-2207

Dear Mr. Saulsman:

Thank you for your letter of June 5, 1985, concerning the waste minimization statement which generators will be required to sign on the Uniform Hazardous Waste Manifest (UHWM) effective September 1, 1985.

As you indicated when you originally spoke to Carolyn Barley in May, your concern was that Boeing Company employees would be reluctant to sign this statement because as individuals they do not have a waste minimization program in place as required by the statement. Our suggestion in response to your concern was for the employee signing the statement to include under the signature line in Item 16 the phrase, "on behalf of The Boeing Company." You indicated in your letter that this solution is satisfactory provided that this phrase can be preprinted on the form. Of course, the individual signing the statement is responsible for the veracity of the statement, as is the company.

We recognize that preprinting this phrase on the form would be a more efficient and less time consuming procedure than requiring Boeing employees to write it in by hand. Additionally, the Agency's March 20, 1985, regulations on the UHWM do not specifically preclude you from preprinting this phrase on the form. Therefore, I have no objections to your proposal.

If you have other questions about the waste minimization statement or the UHWM system, I suggest that you again contact Carolyn Barley (202-382-2217).

Sincerely yours,

for Michael B Cook
John H. Skinner
Director
Office of Solid Waste

UNITED S TES ENVIRONMENTAL PROTECTION A NCY

AUG 5 1985

Ms. Faith Gavin Kuhn
Executive Director/Editor
National Association of Solvent Recyclers
1333 New Hampshire Avenue, N.W.
Suite 1100
Washington, D.C. 20036

Dear Ms. Kuhn:

Thank you for your letter of July 19, 1985, requesting clarification on the types of activities that may be used to satisfy the waste minimization certification as required by the Hazardous and Solid Waste Amendments (HSWA) of 1984. In addition, thank you for the copy of the National Association of Solvent Recyclers' (NASR) latest industry brochure and membership list.

The HSWA establish as national policy the minimization of hazardous waste. The legislation requires waste minimization considerations to be addressed in the Resource Conservation and Recovery Act (RCRA) transport manifests, generator reports, and permits.

Senate Report No. 284, 98th Congress, 1st Session 66 (1983), articulates Congress' intent with regard to the waste minimization requirements in the HSWA. As this legislative history states, both minimization requirements for the manifest and biennial report refer to a certification by the generator that a program is in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable. While the requirement to make this certification is mandatory, the determination of what waste minimization practices are economically practicable are to be made by the generator. The legislative history makes clear that Congress' objective in enacting the requirement for waste minimization certification is to encourage generators of hazardous waste to voluntarily reduce the quantity and toxicity of waste generated.

WH-565A/OSW-WTP-WMED/Room 2811/Phone: 382-7917/plk/8-2-85 [illegible] Key CONTROLS ONLY Disk #1

CONCURRENCES

SYMBOL	WH-565A E.Eby	WH-565A PHansen	WH-565 JLehman				
SURNAME	E. Eby	Hansen	Lehman				
DATE	8/2/85	8/2/85	8/2/85				

EPA Form 1320-1 (12-70)

OFFICIAL FILE COPY

As we previously discussed, and as the legislative history suggests, generators that either recycle wastes on-site or send their wastes off-site to be recycled are exercising a form of waste minimization that may be used to satisfy the waste minimization certification requirement, and may certify as such on the uniform hazardous waste manifest.

The Agency appreciates NASP's concern with the waste minimization certification requirement. If you have any further questions, please let me know.

Sincerely,

John H. Skinner
Director
Office of Solid Waste (WH-562)

Mr. Peter Ashbrook
Head, Hazardous Waste Management
University of Illinois
317 McKinley Hospital
1109 South Lincoln Avenue
Urbana, Illinois 61801

Dear Mr. Ashbrook:

Thank you for your letter of August 26, 1985, to Lee Thomas concerning the availability of guidance on implementation of waste minimization practices at the University of Illinois. I am sympathetic to the challenge you face in managing a large variety of relatively small quantity wastes that, in total, represent a significant quantity.

The Hazardous and Solid Waste Amendments (HSWA) of 1984, establish as national policy the minimization of hazardous waste. The legislation requires waste minimization considerations to be addressed in the Resource Conservation and Recovery Act (RCRA) transport manifests, generator reports, and permits.

The Agency has not developed guidance on waste minimization activities that may be practiced by generators and, at this time, does not intend to. Instead, it is hoped that activities such as source reduction and recycling will be explored by individual generators to reduce the volume or quantity and toxicity of the hazardous waste generated.

Senate Report No. 284, 98th Congress, 1st Session 66 (1983), articulates Congress' intent with regard to the waste minimization requirements in the HSWA. As this legislative history states, both minimization requirements for the manifest and biennial report refer to a certification by the generator that a program is in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable. While the requirement to make this certification is mandatory, the determination of what waste minimization practices are economically practicable are to be made solely by the generator.

OSW:WH-563:JBERLOW:elw:382-7917:rmM2811:9/4/85:AX-50534:Disk 1:Item:25
Final:elw:9/6/85

The legislative history makes clear that Congress' objective in enacting the requirement for waste minimization certification is to encourage generators of hazardous waste to voluntarily reduce the quantity and toxicity of waste generated.

As the legislative history suggests and as the Environmental Protection Agency (EPA) has stated, generators that recycle wastes on-site, send their wastes off-site to be recycled or participate in a waste exchange program are exercising a form of waste minimization that may be used to satisfy the waste minimization certification requirement, and may certify as such.

In addition to the requirements for waste minimization certification imposed by the HSWA, the Amendments also require that a "Report to Congress" be submitted by the EPA by October 1, 1986, assessing the feasibility of establishing waste minimization regulations.

The Office of Solid Waste (OSW) is undertaking extensive technical studies on waste minimization practices including source reduction and recycling in support of the "Report to Congress. These studies will identify and assess current waste minimization practices for generators of hazardous waste. These activities include: good housekeeping practices, source reduction strategies and recycling opportunities for generators. They will also identify generic and specific problems associated with the implementation of waste minimization strategies. In addition, the studies will assess the potential for further applications of the identified waste minimization strategies and will evaluate what steps can be taken to mitigate problems and promote the increased use of waste minimization. This information, as well as recommendations for legislative changes or new regulatory intiatives will be presented in Report to Congress due October 1, 1986. In the interim, OSW will distribute information regarding specific waste minimization practices identified through our technical support studies and technology transfer seminars.

The Agency appreciates your concern with the waste minimization certification requirement. If you should have any further questions, please contact James Berlow, Manager of the Treatment, Recycling, and Reduction Program at (202) 382-7917.

Sincerely,

J. Winston Porter
Assistant Administrator

JAN 17 1986

Mr. William Sloan
Secretary
Hazardous Waste Facilities Siting Board
State of Maryland
Suite 200
60 West Street
Annapolis, Maryland 21401

Dear Mr. Sloan:

Thank you for your letter of December 19, 1985, to Lee Thomas informing the U.S. Environmental Protection Agency (EPA) of the Resolution passed by the Maryland Hazardous Waste Facilities Siting Board (MHWFSB) on October 17, 1985. The Resolution recommends that the EPA provide partial funding for industrial waste exchanges in the U.S., specifically the Northeast Industrial Waste Exchange (NEIWE).

In response to your request for funding, I would like to tell you that Congress has appropriated funds for the Resource Conservation and Recovery Act (RCRA) grant program for FY 1986. These funds will be available through the EPA Regional Offices. The RCRA grant program is used to support a variety of State and local hazardous waste management efforts which focus on innovative waste management activities. These activities include waste reduction, waste exchange, treatment facility siting, providing alternatives to land disposal, shared treatment, and assistance to small quantity generators.

However, due to the uncertainty associated with the recently enacted Balanced Budget and Emergency Deficit Control Act of 1985 (Graham-Rudman provisions), the Agency will not release these FY 1986 funds at this time. When we more clearly understand the ramifications of these provisions and are assured the funds will not be withdrawn, the Regions will be notified and the funds released.

The Resolution adopted by the MIWFSE would be an activity which could be considered for funding by the EPA Regional Offices. I would suggest that a proposal be submitted to the appropriate EPA Regional Office or Offices to be considered for funding. In the case of the MIWFSE, whose services extend beyond one EPA Region, a joint proposal submitted to several Regions requesting a coordinated funding effort may be possible.

Waste exchanges provide an excellent mechanism for information transfer and have the ability to realize actual increases in the use of recycling as a waste management alternative. The Agency applauds the work done by the MIWFSE in adopting this Resolution in addition to the work currently being done by the individual waste exchanges. The strides taken by waste exchanges in recent years have succeeded in reducing the volume of hazardous wastes being disposed in and on the land. I encourage the MIWFSE to explore the possibilities of obtaining grant funds from the EPA Regional Offices.

If you should have any further questions, please contact Elaine Eby of the Treatment, Recycling, and Reduction Program at (202) 382-7930.

Sincerely,

J. Winston Porter
Assistant Administrator

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FEB 6 [illegible]

Mr. Robert Fixter
Assistant Environmental Manager
S&W Waste Inc.
115 Jacobus Avenue
South Kearney, New Jersey 07032

Dear Mr. Fixter:

Thank you for your letter of January 15, 1986, requesting clarification of the term "waste minimization" as it appears in the Hazardous and Solid Waste Amendments (HWSA) of 1984. In particular, your letter requests guidance as to whether the following practice would be considered a waste minimization program.

> A commercial treatment, storage, and disposal (TSD) facility accepts waste solvents and oils from off-site, the TSD blends these wastes on-site to meet certain specifications for use as a fuel extender by off-site Resource Conservation and Recovery Act (RCRA) permitted industrial furnaces. The wastes are subsequently recycled, as fuel extenders and reused in an economically beneficial manufacturing program.

The HSWA establishes as national policy for minimization of hazardous waste, and requires that waste minimization considerations be addressed in RCRA transport manifests, biennial reports, and on-site TSD permits. The Agency has not developed guidance on what constitutes a waste minimization program or a waste minimization activity and, at this time, has no plans to do so. It is hoped that activities such as source reduction and recycling will be explored by individual generators to reduce the volume or quantity and toxicity of hazardous waste generated.

The reports that accompanied the HSWA spelled out Congress' intent with regard to the waste minimization requirements in HSWA. As the report states, both waste minimization requirements for the transport manifest and biennial report refer to a certification by the generator that a program is in place to reduce

OSW-32/written by Elaine.Eby/P. Key CONTROLS ONLY Disk #2
WH-565A/WTB-WMED-OSW/Room 2811/phone:382-7917/plk/1-31-86

CONCURRENCES

SYMBOL	WTB	WTB	WTB	WH-565				
SURNAME	Eby	Burkow	Dellinger	CORSAW				
DATE	2/3/86	2/3/86	2/3/86	2/5/86				

EPA Form 1320-1 (12-70)

the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable, and that the proposed method of treatment, storage or disposal is that practicable method currently available to the generator which minimizes present and future threats to human health and the environment. While the requirement to make the waste minimization certification is mandatory, the nature of the criteria for such certification and the determination of compliance with those criteria are to be made solely by the generator.

This makes it clear that Congress' objective for waste minimization program certification is to encourage generators to seek voluntarily ways or programs to reduce the quantity and toxicity of generated waste. The reports further state that recycling pollutants, contained in effluents, emissions, wastes, or other pollution streams is one, but by no means the only, way of implementing this national policy of waste minimization. A fundamental premise of RCRA is and continues to be to encourage the reuse of materials.

As the legislative history suggests and as the Environmental Protection Agency (EPA) has stated, generators that recycle wastes on-site or send their waste off-site to be recycled are engaging in an activity which may be considered waste minimization.

The Agency appreciates your concern with the waste minimization program definition. If you should have any further questions, please contact James R. Berlow, Manager of the Treatment, Recycling, and Reduction Program at (202) 382-7917.

Sincerely,

Original signed by
Marcia E. Williams
Marcia Williams
Director
Office of Solid Waste (WH-562)

covery, Inc.

02/21/86

Mr. Jack McGraw
United States Environmental
Protection Agency
Solid Waste Division
401 M Street SW
Washington, DC 20460

Reference: Inhouse Liquid Solvent
Recovery Units

Dear Mr. McGraw:

Our corporation, Progressive Recovery is a leading manufacturer of Inhouse Liquid Solvent Recovery Distillation Equipment.

During the past several months, many of our potential clients have questioned the use of inhouse recovery units and if a Federal Permit is required?

Based on my knowledge of the existing Federal Regulation 40, part 261.6, no Federal permit is required for inhouse solvent recovery equipment. This is as long as the following conditions are met:

"Listed" spent solvents (F001 through F005 in 40 CFR 261.31 and CAC 3745-51-31 and spent "Characteristic" solvents (D001 in 40 CFR 261.21 and CAC 3745-51-21) must be stored less than 90 days before they are redistilled. Small quantity hazardous waste gnerators (less than 1,000 Kg per month) are allowed up to 180 days for storage.

Recently, a customer suggested we acquaint ourselves with the redefinition of solid waste finalized in 40 CFR Part 261.1 (c) (4), 261.2 (c), 261.2 (c) (3).

It is my understanding that the Federal EPA strongly encourages generators of spent solvent to recycle rather than dispose of this material!

I would appreciate your comments and opinions on this matter!

Thank you.

1020 North Main Street
Columbia, Illinois 62236
(618) 281-7196

[redacted]Recovery, Inc.

02/21/86

Sincerely,
Progressive Recovery

George D. Culotta
Vice President-Sales

cc: PRI-STL

1020 North Main Street
Columbia, Illinois 62236
(618) 281-7196

MAR 13 1986

Mr. George D. Culotta
Vice President-Sales
Progressive Recovery, Inc.
1020 North Main Street
Columbia, Illinois 62236

Dear Mr. Culotta:

This is in response to your letter of February 21, 1986, in which you requested that we review your interpretation of the applicable regulations for in-house liquid solvent recovery units. In addition, you asked for the Environmental Protection Agency's position regarding recycling of spent solvents by generators.

The spent solvents that you described in your example are RCRA hazardous wastes. F001 through F005 are listed hazardous wastes (40 CFR 261.3) and D001 exhibits a hazardous characteristic (40 CFR 261.21). As a result, the storage, treatment, and disposal of these and other hazardous wastes are regulated under subtitle C of RCRA. However, exemptions from general permitting regulations are provided for certain types of tanks, small quantity generators and operational units reclaiming or recycling hazardous wastes. In your example, no Subtitle C treatment permit is required under Federal regulations for in-house solvent recovery equipment as long as the wastes meet the definition of a recyclable material, and owners or operators of treatment facilities are in compliance with 40 CFR 261.6 requirements.

As part of 40 CFR 261.6 regulation, operational units are exempted from permitting regulations when those operations involve recycling of hazardous wastes. However, there is no exemption for certain recycling practices constituting disposal. Additionally, the storage, transport and generation that precedes this activity are regulated without any special considerations for recycling activities. In your spent solvents example the wastes meet the definition of a recyclable material. If the in-house solvent recovery equipment are in compliance with 40 CFR 261.6 requirements, no RCPA Subtitle C treatment permit is required for the activities of recycling these particular hazardous wastes.

SWER-08403/written by M.Petruska/P.Key CONTROLS ONLY Disk #3
WH-565A/OSW-WTB-WMED/Room 2011/phone #: 382-7917/plk/3-13-86

CONCURRENCES

SYMBOL	WH-563	WH565A	WH-565	WTB	WH565			
SURNAME		JRP			Lehman			
DATE	3/10/86	3/10/86	3/10/86	3/10/86	3/11/86			

EPA Form 1320-1 (12-70)

OFFICIAL FILE COPY

Although storage is subject to regulation as described in the previous paragraph some general exemptions from the storage regulations exist. These exemptions apply when the wastes are either accumulated on-site less than 90 days as stated in the 40 CFR 262.34 requirements, or are accumulated on-site up to 180 days by small quantity hazardous waste generators (less than 1,000 kg per month) as stated in the 40 CFR 261.5 requirements.

I also would like to emphasize that the proposed rule for small quantity hazardous waste generators is scheduled to be promulgated later this month. Although changes might occur in the final rule, the proposed rule for small quantity hazardous waste generators would exempt generators that store wastes for 180 days if they do not accumulate more than 6,000 kg of hazardous wastes during that period. In addition, the August 1, 1985, proposal (50 FR 31304 and 31305) would allow accumulation for 270 days if the waste is being shipped 200 miles or more for off-site treatment, storage, and disposal. I would suggest that you also contact the State authorities of your clients because States may regulate recyclable materials in a different manner.

I also am enclosing the January 4, 1985, final rule defining a solid waste (40 FR 14 through 668), as well as the August 20, 1985, technical corrections to this rule (50 FR 33541 through 33544). These notices provide detailed information on our rationale in defining a solid waste. If you have additional questions, please contact Matt Straus, Chief, Waste Identification Branch, at (202)475-8551.

Finally, I would like to point out that the Hazardous and Solid Waste Amendments of 1984 establish as national policy the minimization of hazardous wastes. It is EPA's policy to encourage environmentally sound techniques that reduce the volume or quantity and toxicity of hazardous wastes generated. The recycling of spent solvents is one of the most frequently used practices for volume reduction. We believe that properly designed and operated solvent recovery can provide effective reduction in the volumes of solvents requiring disposal as hazardous wastes.

Sincerely,

Marcia E. Williams
Director
Office of Solid Waste (WH-562)

Enclosure

STATE OF MARYLAND

Steven P. Quarles, Chairman
[illegible]
Charles R. Baker
Christine U. Eccles, Ph.D.
Richmond W. Hill
Donald A. Jackson

Loren D. Jensen, Phi
[illegible]
Burton L. Mobley
Suzanne M. Pogell
William M. Sloan, Secretary

HAZARDOUS WASTE FACILITIES SITING BOARD

April 2, 1986

J. Winston Porter
Assistant Administrator
U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Solid Waste & Emergency Response
Washington, DC 20460

Dear Mr. Porter:

Thank you for your letter advising the Board that funding for waste exchanges could be considered by the Regional Offices. The message has been circulated among exchange managers. We appreciated Elaine Eby's being present at the Third National Conference on Waste Exchange in Phoenix.

Since your letter, which I received in late January, Lewis Cutler of the Northeast Industrial Waste Exchange has communicated with Regions I, II, III and V, and is prepared to submit an application as soon as one can be considered. Mr. Cutler has also coordinated his work with others, notably Margo Ferguson Siekerka of the Industrial Materials Exchange Service. The IMES -- which, incidentally, is clearly the 1985 leader in business, with $7 million in material or energy value exchanged -- is a part of the Illinois Chamber of Commerce. It, like the Northeast Industrial Waste Exchange, serves states in Region V and other federal regions.

We are finding it difficult to apply without going in different directions, while the situation with the exchanges cries out for unity and coordination. We are in the process of forming a non-profit association, but incorporation is still a couple of weeks off and State acknowledgement probably two months.

I would like to suggest, on behalf of the NIWE, the IMES, and the Board, that you consider a coordinated approach at next week's meeting with regional personnel on Section 8001 funding. A reiteration to the regions of

Secretary's Office • 60 West Street • Suite 200 • Annapolis, Maryland 21401 • Phone: (301) 269-3432

Mr. J. Winston Porter
April 2, 1986
Page Two

the support that you expressed in your letter would also be very much appreciated. Any of us would be glad to discuss the situation with you.

Many thanks for your help.

Very truly yours,

William M. Sloan

Secretary

WMS/csm

cc: Lewis Cutler, NIWE
Margo Siekerka, IMES
Marcia Williams, U.S. EPA/OSW
Chairman, Members and Counsel

4/15/86

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 18 1986

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Mr. Jeffrey L. Dauphin
Waste Systems Institute of Michigan, Inc.
470 Market, S.W.
Suite 100-A
Grand Rapids, MI 49503

Dear Mr. Dauphin:

This letter responds to your request, dated April 1, 1986, for clarification of the waste minimization certification requirement for small quantity generators of hazardous waste.

The waste minimization certification requirement was created by the Hazardous and Solid Waste Amendments of 1984 (HSWA), signed by the President on November 8, 1984. Section 3002(b) of HSWA requires that generators of hazardous waste regulated under Section 3002(a)(5) certify, on the Uniform Hazardous Waste Manifest, that they have in place a program to reduce the quantity and toxicity of the hazardous waste they generate, to a degree determined by the generator to be economically practicable and that the proposed method of treatment, storage, and disposal is that practicable method currently available which minimizes present and future threats to human health and the environment. This statutory provision does not apply to generators of less than 1000 kg per month.

The HSWA also required EPA to establish standards for generators of 100-1000 kg per month. These standards were promulgated on March 24, 1986. On the same day, EPA proposed that the waste minimization certification requirement also apply to 100-1000 kg/mo generators. If the Agency finalizes this proposed requirement, the waste minimization certification statement in item 16 of the Uniform Hazardous Waste Manifest will apply to 100-1000 kg/mo generators just as it applies to generators of greater than 1000 kg/mo. I have enclosed copies of both Federal Register notices, for your information.

The certification contained in item 16 of the manifest form consists of two parts, the waste minimization certification and the general certification of accuracy. Only one signature is required.

The waste minimization certification requirements of HSWA do not authorize EPA to "interfere with or to intrude into the production process by requiring standards for waste minimization;

rather, it specifically provides that the substantive determinations of "economically practicable" and "practicable methods currently available" are to be made by the generator in light of his own particular circumstances. Thus, from an enforcement perspective, the Agency will be concerned primarily with compliance with the certification signatory requirement. Each generator subject to the waste minimization requirement should make a good faith effort to minimize the amout and toxicity of waste generated and to select a means of treatment, storage, or disposal most likely to minimize the present and future threat to human health and the environment (50 FR 28734). The legislative history of HSWA makes clear that "judgements made by the generator [for the purpose of the waste minimization certification] are not subject to external regulatory action (S. Rep. No. 284, 98th Cong. 1st Sess. 67 (1983)).

The HSWA, however, require the EPA to submit a report to Congress, by October 1, 1986, on the feasibility and desirability of: (1) establishing standards of performance or of taking additional action under the Act (RCRA) to require the generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and (2) establishing with respect to hazardous wastes required management practices or other requirements to assure such wastes are managed in ways that minimize present and future threats to human health and the environment. In addition, the report shall include any recommendations for legislative changes which EPA determines are desirable and feasible to implement the national policy of minimizing the generation and the land disposal of hazardous waste by encouraging process substitution, materials recovery, properly-conducted recycling and reuse, and treatment.

The Agency supports all environmentally sound strategies for reducing the amount of hazardous waste which must be disposed of, including waste exchanges. The Agency's position on waste exchanges, therefore, remains consistent with that expressed in John Skinners' March 1, 1985 letter to you.

I hope that this answers your questions about the waste minimization certification requirement. Thank you for your interest in the hazardous waste program.

Sincerely,

Marcia Williams
Director
Office of Solid Waste

Enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Honorable Frederick Boucher
U.S. House of Representatives
Washington, D.C. 20515

Dear Mr. Boucher:

Thank you for your letter of April 18, 1986 regarding your constituent's concern about fees assessed on the generation of hazardous waste. There is currently no such fee assessed under the Resource Conservation and Recovery Act (RCRA). My staff checked with officials in the State of Virginia, which is fully authorized to run its own RCRA program. The State indicated that it, too, does not impose a fee such as the one described by your constituent.

Your constituent may be referring to the waste management tax approved by the House as part of its CERCLA reauthorization bill. See the December 10, 1985 Congressional Record, p. H11666; see also H.Rep. No. 99-253, Part 2, pp. 9-16. The proposed waste management tax actually includes two different taxes: a tax on hazardous waste received at RCRA Subtitle C facilities, and a backup tax on RCRA generators if their waste is not received at a Subtitle C facility within 270 days. As explained below, it appears that your constituent would not be subject to the first tax, i.e., the tax on RCRA Subtitle C facilities. However, your constituent may be subject to the second tax, i.e., the backup tax. We agree that such a tax may serve as a disincentive for recycling. The Administration did not include a backup tax in its CERCLA reauthorization proposal.

Given your description of your constituent's waste, it appears that these used solvents are a hazardous waste under RCRA; see 40 CFR §261.31. The solvents are then sent to a second company where they are stored prior to recovery. Presumably the storage unit would meet the House bill's definition of a "qualified hazardous waste management unit", which is provided in proposed §4675(a)(2) of the Internal Revenue Code of 1954 (IRC). If so, the waste would be subject to the first tax at a rate of $4.15 per wet weight ton. However, the second company would receive a credit or refund for any tax paid for such waste. The credit for certain qualified solvents is outlined in proposed §4673(c) of the IRC. This credit was specifically designed to avoid creating a disincentive for solvent recycling.

Your letter states that after cleaning the used solvents, the second company returns the recovered solvents to your constituent for future use. Presumably this "cleaning" of the wastes is actually reclamation. If so, then these recovered solvents are not wastes. See 40 CFR §261.3(c)(2). This issue is specifically discussed in the preamble of our January 4, 1985 revised definition of solid waste (50 Fed. Reg. 614, 634). Since these solvents are not wastes under RCRA, they would not be subject to the first tax, which is imposed only on certain RCRA hazardous waste. See proposed IRC §§4671(a)(1) and 4675(a)(1).

The second company must properly manage the spent solvents that were not reclaimed. Such spent solvents are typically blended with oil and then sold as fuel. Such waste-derived fuel is still considered a hazardous waste under RCRA. See 40 CFR §261.2(c)(2). The fuel may be burned in an industrial boiler or furnace, or a RCRA Subtitle C incinerator. If so, then the second company may receive a credit or refund under the incineration provision. See proposed IRC §4673(b).

As noted above, your constituent may be subject to the proposed backup tax. That tax is imposed on hazardous waste which is not received at a qualified hazardous waste management unit within 270 days of its generation. See proposed IRC §4674(a). Thus, your constituent's potential liability under this tax would depend on whether one of the second company's RCRA units fits the House bill's definition of a "qualified hazardous waste management unit." If not, then your constituent would be liable for the backup tax. Until the Treasury Department promulgates regulations, the waste would be taxed at the disposal rate.

Let me reiterate that the Administration did not include a backup tax on generators in its proposal to reauthorize CERCLA. In designing a waste-end tax, we decided that the tax ought to be on the management of the waste, not the generation.

Finally, I agree with you that EPA should encourage recycling as a means of reducing the amount of hazardous waste requiring land disposal. The Hazardous and Solid Waste Amendments of 1984 established as national policy the reduction of hazardous waste. In particular, Section 224 of the 1984 RCRA amendments requires EPA to submit a report to Congress by October 1, 1986, on the desirability and feasibility of establishing waste minimization regulations to implement this national policy. As part of this effort, the Agency has identified incentives and disincentives currently affecting the utilization of waste minimization practices such as recycling. The report to Congress will discuss possible actions to alleviate some of the disincentives associated with recycling and to promote further use of recycling and other waste minimization practices.

Please let me know if I can be of any further assistance.

Sincerely,

[illegible] N. Moural

J. Winston Porter
Assistant Administrator

cc: Robert L. Allen, Branch Chief
Waste Management Branch
Hazardous Waste Management Division
U.S. EPA, Region III

William F. Gilley, Director
Division of Solid and Hazardous
Waste Management
Virginia Department of Health

MEMORANDUM

SUBJECT: Briefing Material on Waste Minimization for the American Management Association Interview

FROM: J. Winston Porter
Assistant Administrator

TO: Russ Dawson
Office of the Administrator

This memorandum is in response to your request for briefing material on waste minimization in preparation for the American Management Association's interview with the Administrator on February 18, 1986.

Legislative Mandate for Waste Minimization

The Hazardous and Solid Waste Amendments (HSWA) of 1984, establish as national policy the reduction of hazardous waste. As a result of this legislation, waste minimization considerations must be addressed in various areas of the Resource Conservation and Recovery Act (RCRA) process. These areas include: (1) transport manifests; (2) biennial reports; and (3) on-site treatment, storage, and disposal permits. In addition, the HSWA require the Environmental Protection Agency (EPA) to submit a report to Congress, by October 1, 1986, on the feasibility and desirability of: (1) establishing standards of performance or of taking additional action under the Act (RCRA) to require the generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and (2) establishing with respect to hazardous waste required management practices or other requirements to assure such wastes are managed in ways that minimize present and future threats to human health and the environment. In addition, the report shall include any recommendations for legislative changes which EPA determines are desirable and feasible to implement the national policy of minimizing the generation and the land disposal of hazardous waste by encouraging process substitution, materials recovery, properly-conducted recycling and reuse, and treatment.

Current Activities

The Office of Solid Waste (OSW) is responsible for implementing the waste minimization provisions outlined in the HSWA. The waste minimization certification requirement for manifests and on-site permits became effective on September 1, 1985. This certification requires that the generator certify that he has a program in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable and that the proposed method of treatment, storage, and disposal is that practicable method currently available to the generator which minimizes present and future threats to human health and the environment. In the Codification Rule, EPA articulated Congress' intent with respect to this requirement:

"The amendment does not authorize EPA to interfere with or to intrude into the production process by requiring standards for waste minimization; rather, it specifically provides that the substantive determinations of "economically practicable" and "practicable methods currently available" are to be made by the generator in light of his own particular circumstances. Thus, from an enforcement perspective, the Agency will be concerned primarily with compliance with the certification signatory requirement. Each generator subject to the waste minimization requirement should make a good faith effort to minimize the amount and toxicity of waste generated and to select a means of treatment, storage, or disposal most likely to minimize the present and future threat to human health and the environment" (50 FR 28734).

Also effective on September 1, 1985, was the requirement that a generator include in his biennial report the following information: (1) a description of the efforts undertaken during the year to reduce the volume and toxicity of waste generated; and (2) a description of the changes in volume and toxicity of waste actually achieved during the year in comparison to previous years to the extent such information is available for years prior to 1984. This information will first become available in April 1986. OSW is currently making arrangements to review and summarize this information for inclusion in the waste minimization report to Congress.

OSW also has the lead in developing the waste minimization Report to Congress (RTC) as mandated by the HSWA. In support of this effort, a waste minimization technical support document is being prepared. This document will provide the foundation for development of the RTC and will profile current industrial efforts in waste minimization. In addition, the report will identify incentives and disincentives for utilizing waste minimization practices, State programs to promote waste minimization, and strategies to encourage further use of waste minimization alternatives.

The technical support document is divided into two components: (1) source reduction; and (2) recycling. The source reduction study will profile current and potential waste minimization strategies for 22 different product processes (e.g., electroplating, printed circuit board manufacturing, vinyl chloride production). The recycling study addresses "end-of-pipe" or "end-of-process" wastes by waste groups (solvents, corrosives, metals, halogenated organics) and profiles current and potential recycling practices for these wastes. The recycling study evaluates waste minimization activities such as waste exchanges and commercial recycling operations. This document will be completed and submitted to OSW by the end of February.

Other Supporting Activities

In addition to the activities supporting the requirements and provisions of the HSWA, OSW is also involved with other studies and activities in the area of waste minimization. The Office of Research and Development, Hazardous Waste Environmental Research Laboratory, is presently studying waste minimization practices of the printed circuit board industry. This effort includes on-site visits and detailed analysis of manufacturing and waste management practices.

Tufts University is currently conducting a foreign practices study which will profile current waste minimization efforts in Canada, Japan, and western Europe. The findings of this effort will be incorporated in the waste minimization RTC.

Last year, EPA, with the assistance of the League of Women Voters, sponsored a conference entitled "Waste Reduction - The Untold Story" at Woods Hole, Massachusetts (see attachment for the list of presenters). This conference provided the opportunity for representatives from 22 large companies to showcase their companies' efforts in waste minimization. On June 4-6, 1986, EPA, with the assistance of Tufts University, will be sponsoring Woods Hole II. This year we hope to expand our program to include waste minimization efforts by small and medium size generators.

Waste Minimization Case Studies

In response to your request for several notable examples of waste minimization, attached are four case study summaries which resulted in substantial waste reduction and cost savings for the company. This information was provided by a 1985 report published by the Institute for Local Self-Reliance entitled, Proven Profits from Pollution Prevention - Case Studies in Resource Conservation and Waste Reduction.

In preparation of the RTC, OSW has collected and analyzed over 100 industrial waste minimization case studies utilizing 268 waste minimization techniques. These waste minimization techniques include such activities as process modifications, better operating practices, product substitution, reformulation, recycling, and treatment. Also attached are two summary tables which characterize the type of waste minimization techniques utilized and the amount of waste reduction achieved in the industrial waste minimization case studies.

At the present, we are unable to provide you with any specific data on the use of various waste minimization practices by industry or the volume of hazardous waste which has been eliminated through implementaion of waste minimization practices. Although the technical support document will profile current efforts in waste minimization, our knowledge of waste minimization has not advanced to the stage where we have specific volume data.

Status of the Land Disposal Restrictions and its Effect on Waste Minimization

On January 14, 1986, EPA proposed the framework for a regulatory program to implement the land disposal prohibitions as mandated by Congress. The proposal also included treatment standards and the associated effective dates for two classes of hazardous wastes: solvent wastes and dioxin-containing wastes. Public hearings on the proposed rule have already been held in Dallas, Texas; Washington, D.C.; and Chicago, Illinois. The public comment period closes on March 17, 1986.

Preliminary observations suggest that the HSWA, in particular the waste minimization certification requirements and the land disposal restrictions, will provide incentives for generators to reduce the volume and/or quantity and toxicity of the hazardous waste they generate. It is too early to determine the exact effect the current provisions of HSWA and the other requirements of RCRA will have on a generator's decision to minimize its waste. However, it seems quite clear that the increasing cost of hazardous waste management (i.e., treatment, disposal, liability, insurance) will create increased incentives for waste minimization.

I hope that this information has been helpful to you. In addition, attached is a briefing document which was prepared to outline OSW's waste minimization program. If you should have any further questions, please contact James Berlow, Manager of the Treatment, Recycling, and Reduction Program, at 382-7917 or Elaine Eby at 382-7930.

Attachments

CHARACTERIZATION OF REPORTED WASTE MINIMIZATION TECHNIQUES

Type of Technique	Total Reported Cases	Percent
Process Modifications	113	42
Better Operating Practices	27	10
Product Substitution/Reformulation	13	5
SOURCE REDUCTION (Subtotal)	153	57
RECYCLING	83	31
TREATMENT	32	12
Total	268	100

CHARACTERIZATION OF REPORTED WASTE REDUCTION EFFICIENCY

Waste Reduction Efficiency (Percent)		Total Reported	
		Cases	Percent
> 90		40	37
70-90		18	17
50-70		21	19
< 50		29	27
	Total	108	100

PRESENTERS AT THE "SOURCE REDUCTION - THE UNTOLD STORY" CONFERENCE

Woods Hole, Massachusetts
June 19-21, 1985

Allied Corporation

American Cynamid

Amoco Chemicals

AT&T Technologies

Chevron Chemical Company

Chrysler Corporation

Dow Chemicals

Eastman Chemical Division - Eastman Kodak

E.I. DuPont de Nemours and Co.

Exxon Chemical Americas

Hewlett Packard

IBM

ICI Americas, Inc.

3M

Monsanto Company

Occidential Chemical Corporation

Olin Corporation

PPG Industries

Rohm and Haas

Shell Oil Company

Union Carbide

Velsicol Chemical Corporation

Report to Congress

Minimization of Hazardous Waste

Executive Summary
and
Fact Sheet

October 1986

Printed on 75% Recycled Paper

F-A

Report to Congress

MINIMIZATION OF HAZARDOUS WASTE

Summary of Recommendations

The Environmental Protection Agency has concluded that mandatory standards of performance and required management practices are not feasible or desirable at this time. The Agency recommends that the effect on waste minimization of the land disposal restrictions and other HSWA mandates, as well as amendments to CERCLA, be quantified and analyzed. EPA will report back to Congress on this determination in December 1990, the earliest date at which it believes a recommendation on the need for a major waste minimization regulatory program could be made. Until that time, however, EPA recommends a three point waste minimization strategy:

Information Gathering

Continuing collection of information on waste stream volume and composition, generation rates by various types and sizes of generators, adequacy of capacity for TSD facilities, and the cumulative effect of HSWA requirements on voluntary waste minimization practices.

Core Waste Minimization Program

- Development and publication of informal guidance on waste minimization for the purpose of the reporting and certification requirements of HSWA Sections 3002 and 3005.
- Provision of a technical and information assistance program to generators and to States to aid in the development of waste minimization programs.
- Assistance to specific States to develop programs for providing direct technical assistance to generators (e.g., using waste audits, dissemination of technical information, applied research on new applications of existing technology).
- Highlight ongoing research and development and economic feasibility studies that might serve an entire region or have regional application.
- Development of an information system on waste minimization, accessible by the States.
- Implementation of mandatory controls, as needed, for controlling the generation of wastes for specific industries or processes using current authority under TSCA Section 6.
- Incorporation of waste minimization into the review of TSCA Premanufacture Notices.

Longer Term Options

After evaluation of information gathered in the short term, EPA may better assess in its 1990 report to Congress that additional authority to adopt mandatory standards of performance or management practices as a means of reducing wastes would be warranted.

In the interim, EPA will continue to examine the specific elements of the "core" waste minimization program and consider the need for longer term options, if needed. As part of the next RCRA reauthorization, EPA will provide Congress with its most current assessment of the need to modify the existing waste minimization requirements for generators and TSDFs. Among the possible options to consider would be:

- To prohibit, where appropriate, certification of certain types of waste management practices as waste minimization.
- To specify what may be certified as waste minimization.
- To define necessary documentation for certifications that state that waste minimization is not economically practicable.

Report to Congress on Minimization of Hazardous Waste

EXECUTIVE SUMMARY

This Report to Congress is submitted in response to the requirements of Section 8002(r) of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, and the Hazardous and Solid Waste Amendments (HSWA) of 1984.[1] Under this section, the Administrator of the Environmental Protection Agency (EPA) is required to submit a Report to Congress by October 1, 1986, recommending any legislative changes that are feasible and desirable to implement HSWA's policy with respect to the minimization of hazardous waste:

> The Congress hereby declares it to be the national policy of the United States that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored or disposed of so as to minimize the present and future threat to human health and the environment.

Section 8002(r) requires the Administrator to evaluate specifically the feasibility and desirability of:

1. Establishing standards of performance or of taking other additional actions under RCRA to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and

---

[1] Reflecting common usage, the amended Solid Waste Disposal Act will hereafter be generally referred to as RCRA. Additions to RCRA made by the 1984 amendments will be referred to in the text as HSWA.

2. Establishing, with respect to hazardous waste, required management practices or other requirements to ensure such wastes are managed in ways that minimize present and future risks to human health and the environment.

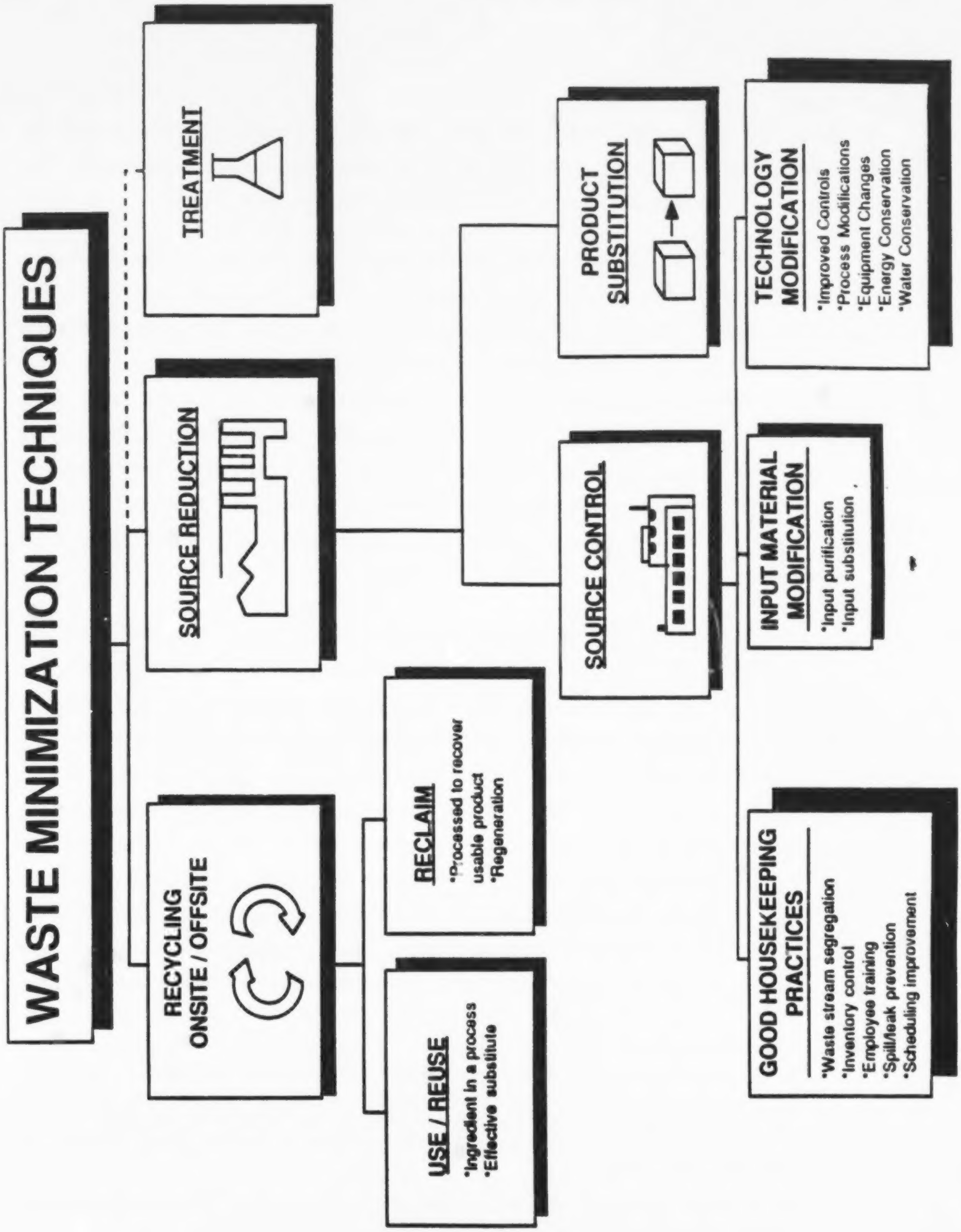
Definition of Terms

The following definitions, based in part on the interpretations presented below, are crucial to the recommendations made in this report (see also Figure 1):

> **Source reduction** refers to the reduction or elimination of waste generation at the source, usually within a process. Source reduction measures can include some types of treatment processes, but they also include process modifications, feedstock substitutions or improvements in feedstock purity, various housekeeping and management practices, increases in the efficiency of machinery, and even recycling within a process. Source reduction implies any action that reduces the amount of waste exiting from a process.
>
> **Recycling** refers to the use or reuse of a waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process. It also refers to the reclamation of useful constituent fractions within a waste material or removal of contaminants from a waste to allow it to be reused. As used in this report, recycling implies use, reuse, or reclamation of a waste either onsite or offsite after it is generated by a particular process.
>
> **Waste minimization** means the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste, or (2) the reduction of toxicity of hazardous waste, or both, so long as the reduction is consistent with the goal of minimizing present and future threats to human health and the environment.

In the broadest sense, the HSWA defines waste minimization as any action taken to reduce the volume or toxicity of wastes. That definition includes the concept of waste treatment, which encompasses such technologies as incineration, chemical detoxification,

FIGURE 1


WASTE MINIMIZATION TECHNIQUES
RECYCLING ONSITE / OFFSITE
SOURCE REDUCTION
TREATMENT
USE / REUSE
*Ingredient in a process
*Effective substitute
RECLAIM
*Processed to recover usable product
*Regeneration
SOURCE CONTROL
PRODUCT SUBSTITUTION
GOOD HOUSEKEEPING PRACTICES
*Waste stream segregation
*Inventory control
*Employee training
*Spill/leak prevention
*Scheduling improvement
INPUT MATERIAL MODIFICATION
*Input purification
*Input substitution
TECHNOLOGY MODIFICATION
*Improved Controls
*Process Modifications
*Equipment Changes
*Energy Conservation
*Water Conservation

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biological treatments, and others.[2] The Agency has already embarked on a broad program for waste treatment; thus, this report focuses on source reduction and recycling, the two aspects of waste minimization where basic options still remain open.

Section 1003 of HSWA establishes the general national policy in favor of waste minimization and refers to the need to reduce the "volume or quantity and toxicity" of hazardous wastes. EPA does not interpret this language to indicate that Congress rejected volume reduction alone (with no change in the toxicity of hazardous constituents) as being a legitimate form of waste minimization. A generator that reduces the volume of its hazardous waste, even if the composition of its waste does not change, is accomplishing beneficial waste minimization. EPA believes that waste concentration may occasionally be a useful waste minimization technique (e.g., in preparing materials for recycling). The key concept, however, is that waste minimization must be protective of human health and the environment.

Because both volume and toxicity of wastes present dangers to human health and the environment, measuring the effectiveness of waste minimization will be complex. First, waste minimization measures are likely to be process and industry specific, implying that different measurement techniques might be needed in different contexts; second, any mandatory requirements for reducing the volume or toxicity of generated waste should directly relate to expected reductions in risk to human health and the environment. EPA has already developed data and methodologies that can be used to evaluate the risks of many types of waste streams, as well as the risk reductions associated with waste management practices.[3] These evaluation techniques will continue to improve and become more effective as a tool in regulatory decision making. EPA therefore intends to use such assessments as a means of measuring progress in waste minimization and to help establish priorities among or within possible waste minimization regulatory schemes. This approach is consistent with the general principle that any waste minimization regulations should seek to reduce significant remaining risks.

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[2] Section 1003(a)(6) of HSWA states that the objectives of "promot[ing] the protection of health and the environment and conserv[ing] valuable material and energy resources" can be done by "minimizing the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitutions, materials recovery, properly conducted recycling and reuse, and *treatment*" [italics added].

[3] These include, for example, the Liner Location Model and the RCRA Risk/Cost Analysis Model (usually referred to as the Waste-Environment-Technology or W-E-T model).

Why Minimize Waste?

The RCRA program over the past ten years has focused primarily on correcting the effects of years of poor management of hazardous wastes by bringing treatment, storage, and disposal facilities into compliance with national standards that are protective of human health and the environment. HSWA has continued this policy, but has also shifted the emphasis of the program away from reforming land disposal practices to a reliance on waste treatment. Because of its potential for contamination of other environmental media (e.g., ground water), land disposal—even under strict control—is recognized as the least desirable method of managing hazardous wastes.

The move toward treatment is a major step forward, but is not a complete answer. Reforms in land disposal practices and installation of new hazardous waste treatment capacity are effective responses to managing this country's hazardous waste, but they do not address the generation of these wastes. Both Congress and EPA believe that preventing the generation of a waste, when feasible, is inherently preferable to controlling it after it is generated. Waste minimization can be viewed as a means of reducing the introduction of hazardous constituents into all environmental media.

Current environmental control programs are designed to protect human health and the environment. However, control technologies are never 100 percent efficient, and compliance with regulations under any environmental program can never be perfect, even with the most stringent enforcement program. Waste minimization can also address the risks of breakdowns in waste management systems.

In addition to achieving human health and environmental benefits by reducing the volume and/or toxicity of hazardous wastes, waste minimization can also relieve shortages of treatment, storage, and disposal capacity. The capacity to accept wastes diverted from land disposal will be especially limited over the next few years while new facilities are

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under construction and treatment alternatives are being developed. This process may be slow, since public opposition makes new hazardous waste facilities extremely difficult to site. Furthermore, land disposal will continue to be required into the foreseeable future, even if wastes disposed of in or on the land are detoxified first; hence, capacity needs will always be a concern. Finally, all forms of waste management—treatment or land disposal—must allow for industrial growth and thus the need for additional capacity. By reducing per unit product generation rates, waste minimization can provide at least a partial answer to these problems.

Incentives and Disincentives for Waste Minimization

Strong incentives already exist to promote waste minimization in the private sector, including (1) dramatic increases in the price of all forms of hazardous waste management, partially caused by Federal and State standards, (2) difficulties in siting hazardous waste management capacity, (3) permitting burdens and corrective action requirements, (4) financial liability of hazardous waste generators, (5) sharp increases in the cost of commercial liability insurance, coupled with a steep dropoff in its availability, and (6) public pressure on industry to reduce the production of waste. There are also countervailing disincentives. Figure 2 covers the incentives and disincentives that surround the various waste minimization techniques.

Incentives for Waste Minimization

Increases in the costs of hazardous waste management: EPA and State regulations have been the primary cause of increased costs in treatment, storage, and disposal of hazardous wastes, especially in relation to landfills, surface impoundments, and storage and accumulation tanks. The current series of land disposal restrictions under HSWA will limit the number of untreated wastes that can be disposed of on land and thus are likely to increase the cost of disposal. HSWA also imposes more stringent standards on surface impoundments, which will mean that about half of those now in operation will close. In addition, the recently promulgated hazardous waste tank rules[4] will

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[4] 51 FR 25421, July 14, 1986

	Source Reduction	Offsite Recycling	Onsite Recycling
INCENTIVES			
Increased Cost of Waste Management	●	●	●
Difficulties in siting new HW management facilities	●		●
Permitting Burdens and Corrective Action Requirements	●	●	●
Financial Liability of HW Generators	●		●
Shortages of Liability Insurance	●		●
Public Perception	●	●	●
DISINCENTIVES			
Economic Barriers			
–Lack of Capital	●		●
–Financial Liability		●	
Technical Barriers			
–Attitudes toward unfamilar methods	●	●	●
–Batch Processes			●
–Lack of information	●	●	●
–Technical Limits of Process	●		
–Technical Quality Concerns	●		
Regulatory Barriers			
–Need to Obtain TSD Permit	●	●	●
–Perceived Stigma of Man'g Haz. Waste		●	●
–Revisions to Other Env. Permits	●	●	●

FIGURE 2 INCENTIVES AND DISINCENTIVES FOR VARIOUS WASTE MINIMIZATION TECHNIQUES

also increase waste management costs. Because of these three factors, generators must find alternative means for treating, storing, or disposing of their wastes.

Prices for such alternative waste treatment are expected to rise as generators compete for scarce treatment capacity (such as incineration or chemical detoxification). EPA has, in fact, already identified shortages of treatment and disposal capacity for solvent and dioxin wastes in its proposed regulations.[5]

Overall, the increased costs of waste management provide a strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of source reduction and offsite and onsite recycling techniques.

Difficulties in siting hazardous waste treatment, storage, and disposal capacity: The land disposal restrictions program, as mandated by HSWA, is creating a strong demand for substantial new waste treatment, storage, and disposal capacity. Hazardous waste managers are therefore seeking new sites and planning to expand existing ones, but in the process they are encountering the familiar problem of "not in my community." While there are some instances where States have been successful in helping to site new hazardous waste management facilities, local resistance tends to be extremely hard to overcome. This intense public opposition to the siting of many types of hazardous waste facilities may cause shortages to persist even when market demand is strong. Generators' only alternative in many cases may therefore be a reliance on source reduction and onsite recycling to reduce the amount of waste they would otherwise send to offsite management facilities.

Permitting burdens and corrective action requirements: Even though the demand for new treatment and disposal capacity will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of treatment and disposal. No new hazardous waste management facility may be constructed until it has acquired a RCRA permit—a costly process that usually takes several years to complete. In addition, all permits issued after November 8, 1984, include provisions requiring owners and operators to take corrective action for releases of hazardous waste, regardless of when it was placed in the unit, both within *and beyond* property boundaries as necessary to protect human health and the environment. This potentially very expensive requirement applies to all facilities seeking a new RCRA permit, including both existing and new facilities. Additionally, even though the demand for new treatment and disposal capacity will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of treatment and disposal.

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[5] 51 FR 1729, January 14, 1986

Thus, the increased costs of permitting burdens and corrective action provide still another strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of source reduction and offsite and onsite recycling techniques.

Financial liability of hazardous waste generators: Generators using offsite treatment, storage, or disposal face financial liability for two reasons: (1) there is a potential for mismanagement of wastes by facility operators, and (2) there is the possibility of improper design of the disposal facility itself. Even careful evaluation of facility management cannot reduce these risks to zero. A generator risks incurring liability when the treatment, storage, or disposal facility (TSDF) owner or operator cannot or will not pay for remedial or corrective actions made necessary by migration of wastes. In these situations, generators can be held liable under common law for absolute, strict, joint and several liability. In addition, the imminent and substantial endangerment provisions in Sections 106 and 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), state a generator or generators can be held financially responsible for the entire cleanup or restoration of a facility. When less waste is generated, it reduces potential liability for future disposal and thus is an incentive for both source reduction and onsite recycling.

Shortages of liability insurance: The traditional means for obtaining coverage for potential hazardous waste management liabilities is through insurance, but, for many generators and owners or operators of TSDFs, liability insurance is no longer available, or is available only at extremely high cost. This is particularly true of Environmental Impairment Liability (EIL) insurance, which until 1985 was an often-used financial instrument for generators and owners and operators of TSDFs to protect themselves from third-party and government claims for damages resulting from environmental releases of hazardous substances. In recent years, premiums have increased 50 to 300 percent, policies have been cancelled even where loss ratios have been excellent, and many companies have difficulty obtaining coverage at any price. In order to insure themselves against liability, TSDFs who must comply with Sections 3004 and 3005 (e) of RCRA[6] have resorted to creative methods to obtain coverage.[7] Until fundamental changes occur in the insurance marketplace, many generators and TSDFs will continue to have difficulty meeting liability requirements.

Increases in insurance costs or an inability to obtain insurance will result in higher treatment and disposal costs or the loss of available treatment or disposal capacity. This will provide a strong incentive to reduce the quantity of waste to be disposed of through the application of source reduction and onsite recycling techniques.

Public perception of company responsibilities: While the strongest incentives for implementing waste minimization techniques are probably economic, many companies are establishing waste minimization programs out of sensitivity to public concern over toxic chemicals. This type of corporate good citizenship is felt to produce good relations between industry and the public. Available information indicates that the larger companies are most likely to perceive public relations benefits in waste minimization; however, some medium and small size companies are acting under the same motives.

Disincentives for Waste Minimization

Economic barriers: Even though waste minimization practices often lead to cost savings, availability of capital for plant modernization is often a significant obstacle to their implementation. Although major companies may have sufficient access to upgrade inefficient processes, small and medium sized companies often do not. Firms that have recently modernized their facilities have reduced incentive to reinvest in alternative processes. Obstacles to plant modernization adversely affect the implementation of source reduction and onsite recycling when these involve process modifications.

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[6] Generators do not have to obtain liability insurance under RCRA.

[7] New instruments they have developed include: (1) formation of associations—captive stock or mutual insurance companies, (2) licensed carrier fronting programs for trust funds in which banks hold funds to cover liability, (3) letters of credit, (4) self insurance, and (5) corporate guarantees.

Financial liability can, in at least one circumstance, also be a significant disincentive for waste minimization because generators who send waste offsite may be liable under CERCLA and common law for damages caused by their wastes, even if the wastes have left the plant and are no longer under the firm's control. They may therefore not use available offsite recycling.

Technical barriers: Some firms may be reluctant to make any modifications to their production processes for fear of risking the technical quality of their final product. While these fears may not be well-founded, they can be a significant impediment to innovation.

There may also be, however, significant practical limits to waste minimization, especially with respect to source reduction, even where firms are actively seeking to minimize waste. Certain products simply cannot be manufactured without producing hazardous wastes; excessive waste minimization requirements would, in such cases, remove products from the market or put companies out of business entirely. A hazardous waste analog to the zero discharge policy, calling for across-the-board cuts of fixed percentages of waste generated, is therefore not realistic because, in some situations, possible source reductions may turn out to be minor and achievable only at great expense.

Another technical consideration affecting waste minimization is that industries producing high volume or high toxicity wastes often operate largely through batch processes. This can present problems for certain onsite recycling techniques (e.g., while light colored off-specification batches of paint can be blended into subsequent darker colored batches, the opposite is not always true).

Similarly, offsite recycling is often technically limited by process realities and administrative logistics. Off-specification chemicals (such as pesticides or pharmaceuticals) are examples of products with little onsite or offsite recycling potential. Even where wastes are technically recyclable, it may be difficult to accumulate enough waste to make the activity economically attractive. With respect to offsite recycling, it may be hard to establish permanent and stable relationships, either onsite among various production lines

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or offsite among firms; generator and user processes have to be synchronized, purity may vary over time, volumes of wastes available may not meet minimum reuse needs, transportation costs have to be acceptable, and price variations in feedstocks and in product prices inevitably play a crucial role.

Finally, the most significant technical barrier to waste minimization may often be a lack of suitable engineering information on source reduction and recycling techniques. Available information suggests that this is most often the case with small and medium sized companies.

Regulatory barriers: Some of the provisions of current environmental statutes, including RCRA, tend to discourage waste minimization. Some examples include the following:

- Source reduction sometimes requires the installation of new machinery that can, under RCRA, be considered "treatment." This in turn may require a plant to obtain a permit as a treatment, storage, and disposal facility (TSDF).
- Commercial recycling facilities that wish to increase their operations might be reluctant to do so if the expansion were to require a revision of their NPDES water pollution permit to authorize a change in the composition of their discharges or allow for larger flows.
- The new definition of solid waste, promulgated by EPA to eliminate loopholes in RCRA controls and inhibit unsafe (or "sham") recycling, brings some additional wastes into the hazardous waste system. This seems to be inhibiting some plants from sending these wastes offsite for recycling, since many companies perceive that manifested wastes present greater financial liability for offsite activities out of their immediate control. In addition, out of anxiety over potential financial liabilities, some companies not currently in the hazardous waste system may be reluctant to undertake any waste minimization program that would require them to accept manifested hazardous waste (e.g., certain offsite recycling practices) or take other measures that would bring them officially into the hazardous waste management system.

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Current Waste Minimization Requirements

At present, there are three formal statutory requirements relating to waste minimization, all of them enacted as part of the 1984 amendments.

1. Section 3002(b) of HSWA requires generators to certify on their waste manifests (mandated under Section 3002(a)) that they have in place a program "to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable."

2. Section 3005(h) of HSWA requires the same certification in relation to any new permit issued for treatment, storage, or disposal of hazardous waste.

3. Section 3002(a)(6) of HSWA requires, as part of any generator's biennial report to EPA, that the generator describe "the efforts undertaken during the year to reduce the volume and toxicity of waste generated" as well as "changes in volume and toxicity of waste actually achieved during the year in question in comparison with previous years, to the extent such information is available for years prior to enactment of [HSWA]."

These requirements should increase the awareness of generators and facility owners and operators of the importance of minimizing hazardous wastes, and might serve as the basis for more specific and farther reaching requirements. However, the present requirements are not restrictive; the generator determines whether any particular waste minimization approach that might apply to his or her process is economically practicable.

Although the biennial reports should provide useful insight into what generators are actually doing to reduce wastes, they are not likely to provide definitive information. The reports due this year (1986) will be the first to include waste minimization requirements, and the quality of information they contain is expected to vary widely. As yet, for example, there is no formal definition of the meaning of the term "toxicity," or any guidance on the way to measure waste volume. In addition, generators are not likely to provide information that they consider confidential.

EPA is therefore conducting a study to determine how the waste minimization statement on the biennial report can be modified to improve the quality of information being reported. The Agency plans to provide uniform guidance directly to the States and to generators on the content of these reports in time for their 1988 submission. Future information provided in the report will then allow EPA to better identify trends in waste minimization technologies applied by generating facilities.

Evaluation of Available Options for Waste Minimization

Congress specifically required the Agency to report on the desirability and feasibility of establishing mandatory standards of performance for waste minimization or of taking additional actions under RCRA to reduce the volume or quantity and toxicity of hazardous waste and of establishing required management practices to achieve minimization. It also requested any recommendations for legislative changes to implement the national policy of waste minimization. This report details EPA's evaluation of the following options to minimize hazardous wastes.

Standards of Performance

Mandatory standards of performance for minimizing wastes could take various forms, but in all their variations they are markedly different in concept from the type of performance standards typical of the air and water pollution control programs. In these other programs, performance standards are end-of-pipe standards that allow flexibility to modify processes or add control technologies. Performance standards for waste minimization would depend substantially on internal modifications of industrial processes. Such standards would mark a major departure from past practice and would require statutory amendments. At present, mandatory performance standards are not authorized under RCRA.

EPA has evaluated three variations of performance standards in this report:

1. Specific standards limiting the volume or toxicity of wastes,
2. Prohibition or restriction of specific waste streams, and
3. A phasedown permit system, wherein total waste generation levels for one or more industries or waste streams are specified and then

> reduced ("phased down") over time. Under this option, trades among firms for generation rights would be encouraged.

EPA believes that all these options raise significant implementation concerns and should be adopted only after careful evaluation of emerging trends and patterns of waste generation. It is important that the option selected be the most effective method to minimize hazardous waste for a particular industry. All performance standard options would be costly and time consuming to design and would, therefore, be infeasible to implement in the next four to six years. If it becomes clear after implementation of the land disposal restrictions program that there are specific residual hazardous waste problems that are not being resolved through response to these requirements, then additional prescriptive action may be appropriate. EPA might find that the Toxic Substances Control Act (TSCA), especially Section (6)(a)(A), is a more appropriate method than RCRA regulations to resolve residual hazardous waste problems.

A comprehensive command-and-control performance standard program of the traditional type would cost on the order to $5 to $7 million per standard to design and implement, and would require staff commitments at least as high as the effluent guidelines program for water or the new source performance standards program for air. At the present time, however, there are hundreds of discrete industrial processes to examine, and it is difficult to project without further information how many may require standards. Under the most realistic circumstances, it would take at least ten years after Congressional authorization to design and fully implement such a program.

Prohibition or restriction of specific wastes would presumably be simpler in regulatory structure and more selectively applied than performance standards, but would still require extensive research into processes and waste management techniques. Furthermore, responsible use of prohibition authority often requires substantial analysis of the feasibility of less severe measures and, therefore, can also be costly to evaluate.

A phasedown permit system would be somewhat different in concept and operation from a command-and-control performance standard approach. Because it would not set specific engineering standards for each industry, the burden on EPA for developing the program would be considerably less than for a conventional standard-setting process.

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Incentives for trading among firms would be inherent in the system, since the number of permits would be limited to less than the current level of waste generated. The eventual value and distribution of permits would be set by the marketplace, with waste reductions coming from those firms that could reduce most cost-effectively. These firms would be able to sell any unused permits on the open market as "waste reduction credits." Moreover, since EPA would phase down the amount of waste generation allowed, the permits would increase in value over time, creating a continuous incentive to reduce waste further.

Phasedown permits would cost society far less than other performance standard options for achieving a given level of waste reduction if there are sufficiently wide variations in unit control costs among generators and if trades are actually made among firms. They do, however, raise novel implementation problems. Two concerns are the initial distribution of permits and the degree of trading to be allowed. However, these issues may be resolvable, as demonstrated by EPA's recent program to phase down the lead content of gasoline. A third concern is how to determine the rate of the phasedown and the amount of hazardous waste allowed at the end of the phasedown period.

Under any of these options, EPA would consider exempting small quantity generators from the requirements or would consider subjecting them to simplified and less burdensome requirements. Because small quantity generators collectively account for only a small fraction of the wastes generated annually,[8] subjecting them to stringent and expensive regulations may not be cost-effective or provide additional protection of human health and the environment.

Management Practices

Management practices, as defined in this report, are procedures or institutional policies within a service or manufacturing operation that result in a reduction in hazardous waste generation. They are a step beyond the directives established by performance standards and include requirements restricting particular disposal practices, requirements for the handling of wastes as they are generated, and requirements for controlling the waste generation system.

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[8] Small quantity generators regulated under RCRA are those who generate between 100 and 1,000 kilograms of hazardous waste per month. According to the *National Small Quantity Hazardous Generator Survey*, conducted for the Office of Solid Waste in 1985, small quantity generators, including those who generate less than 100 kilograms per month, collectively account for less than one half of one percent of the total quantity of waste generated annually.

Three management practices are discussed below. The first would ban the landfilling, treatment, or incineration of potentially recyclable wastes. The second would require the segregation of wastes to enhance recycling potential. The third would require mandatory waste audits.

Banning the landfilling, treatment, or incineration of potentially recyclable wastes would likely be controversial and possibly inefficient. In addition, while it would be possible to make sure that no proscribed waste is landfilled, treated, or incinerated, it would be exceedingly difficult to ensure that all such waste is properly recycled instead, thus making it difficult to enforce. Noncompliance (e.g., illegal dumping) would potentially be substantial.

A second possibility would be a requirement for segregation of waste streams and banning the mixing of waste streams that are potentially recyclable. This includes the isolation of hazardous materials from nonhazardous materials or the isolation of liquid from solid waste. The segregation of wastes does have the potential in selected instances to be economically attractive, and could, in fact, save some firms significant sums of money by reducing treatment and disposal costs, lowering expenses for the purchase of raw materials, and/or generating a reclaimed product that can be marketed or sent to a waste exchange. Waste stream segregation might, therefore, become economically attractive without additional regulation. It is conceivable that new prohibitions on land disposal and dramatically increased costs for all forms of disposal, coupled with substantial efforts to increase industry awareness of recycling possibilities, could provide adequate information and incentive for segregation without making such action a regulatory requirement.

Waste audits can be an effective means to identify opportunities for waste minimization, making audits mandatory, however, could undermine their effectiveness. While the direct costs of waste audits for industry are not extremely high (on average

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$10,000 to $20,000 per audit for an uncomplicated facility)[9], requiring every waste generator to conduct an audit could have some detrimental effects. If they were seen as a Federal requirement rather than as a corporate initiative, plant personnel might tend to be less than forthcoming and the results of such audits often might be discounted and disregarded. A mandatory program might also require EPA to develop implementing regulations to address who is qualified to conduct waste audits and how audits should be conducted, and to monitor possible reporting requirements. Since it would be difficult to require compliance with the recommendations of a waste audit, such efforts do not seem justified.

It appears more desirable for EPA to promote voluntary waste audits on their own merits as a useful waste management tool, such as through a technical assistance program implemented through the States (see below). EPA and the States could develop programs that would include State certification and listing of qualified waste minimization auditors, targeted assistance programs for onsite audits, and development of model checklists and protocols for conducting audits. In the context of a voluntary audit approach, such programs should be less burdensome to develop and more flexible to implement than under a mandatory regime; thus, it is suggested as an EPA initiative.

Legislative Amendments to HSWA

EPA currently interprets the certification requirement under HSWA Section 3002 (generator standards) and Section 3005 (permit standards) as prohibiting the development of substantive requirements to generators on what constitutes appropriate waste minimization. As the Senate Report on the certification process emphasizes, the intent of the current requirement is merely to encourage generators to consider specifically the desirability and feasibility of waste minimization; it does not require specific waste minimization action.

The Agency believes that generators should continue to determine what their waste minimization options are and, at this time, that EPA should not make process related decisions to force waste minimization. However, EPA is further considering an option to amend the current legislation to allow EPA to define acceptable waste minimization practices. This authority could allow EPA to specify general practices that could or could not be certified as waste minimization (e.g., those practices that result in adverse cross-media pollution transfers). EPA is continuing to evaluate this change to the waste minimization certification statement, and will provide Congress a further assessment of the need to modify these requirements. Among possible options to consider include:

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[9] For smaller facilities, the costs could be substantially lower, perhaps under $5,000; however, for large, complex facilities, the costs could be substantially higher.

- Prohibit, where appropriate, certification of certain types of waste management practices as waste minimization.
- Specify what may be certified as waste minimization.
- Define necessary documentation for certifications that state that waste minimization is not economically practicable.

As additional information becomes available, the Agency could use this discretionary authority to focus on specific industries that continue to create potential risks to human health and the environment.

While small quantity generators might be subject to such additional reporting responsibilities under this option, EPA could consider subjecting them to less rigorous and burdensome requirements than those affecting large quantity generators.

Other Options

A number of other waste minimization options have been identified in the course of preparing this report. A full list of available options is found in the technical support document for this report, *Waste Minimization Issues and Options*. Several of the options listed there are not discussed here for various reasons: either they have been considered already under other authority (such as the provisions for a waste-end tax now under consideration as part of the CERCLA reauthorization), or they have been found, on further review, to be unworkable as part of RCRA (e.g., enforcement bounties). Appendix B to this report lists options that have *not* been evaluated or presented here and explains the reasons for their exclusion.

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Two basic options for waste minimization that the Agency believes should definitely be considered as part of a short- or long-term waste minimization strategy are (1) technical assistance for waste minimization, implemented in cooperation with the States, and (2) modifications to Federal procurement practices to avoid discriminating against recycled commodities and, where appropriate, to support development of markets in recycled commodities.

An active, aggressive, and sustained program for technical assistance appears to be the strongest option available to promote waste minimization, especially in the near term. Carried out in cooperation with the States, such a program could be aimed primarily at small[10] and medium sized companies, which currently have the least access to information on how to minimize their wastes. The program's purpose would be to encourage firms to include waste minimization efforts in their hazardous waste management planning, to provide access to technical information, and to encourage the development of markets for recyclers and recycled materials. No new legislative authority would be required to launch such a technical assistance effort, but adequate and sustained support by Congress would be necessary over the next ten years if it were to achieve its potential.

RCRA already provides authorization for EPA to encourage revision of Federal procurement practices to promote the use of recycled products. Section 6002 of RCRA requires procuring agencies to amend Federal procurement practices to avoid unnecessary discrimination *against* recycled products, and requires EPA to promulgate procurement guidelines that actively promote the procurement of recycled products. This strategy may help achieve substantial increases in the market share of recycled products, particularly where the Federal government is a major consumer of a product. In such instances, a Federal preference for a recycled product may make the product economically viable. EPA should work with agencies that are in the best position to create such markets, including the Department of Defense and the Department of Energy.

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[10] "Small" companies are not intended to include only Small Quantity Generators as defined under RCRA. A technical assistance program would also be useful for small quantity generators, but the degree of emphasis on this group would have to be carefully reviewed. While small quantity generators do need (and often request) technical assistance, the available data suggest, as noted earlier, that they contribute only a very minor fraction (about one-half of one percent) of hazardous waste volume nationally.

Recommendations

At this time, the Agency believes that generators should continue to determine which waste minimization techniques are economically practicable and that EPA should not specify requirements for waste minimization.

If, after implementation of the other pertinent provisions of the HSWA, the Agency decides that standards of performance or required management practices are needed to protect human health and the environment, it will then request the necessary additional authority from Congress. EPA proposes to report to Congress on this issue in December 1990, the earliest date at which it believes a recommendation on the need for a mandatory waste minimization program could be made.

EPA does plan to expand its waste minimization efforts as discussed below in the context of EPA's proposed three-point waste minimization strategy.

The elements of this strategy are:

1. **Information Gathering:** Detailed data on industry's response to the land disposal restrictions program and other existing waste minimization incentives must be gathered in order to make a final determination on the desirability and feasibility of performance standards and required management practices.
2. **A Core Waste Minimization Program:** During the interval when the new provisions of HSWA are taking effect, EPA will launch a strong technical assistance and information transfer program through the States to promote voluntary waste minimization in industry, government, and the non-profit sectors of the economy. It will also work with Federal agencies to encourage procurement practices that promote the use of recycled and reclaimed materials.
3. **Longer Term Options:** Based on an analysis of the new data gathered under (1) above, performance standards and other mandatory requirements can be imposed, if necessary, once the

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HSWA amendments have taken full effect and their impacts on waste generation have been assessed.

Information Gathering

Agency actions to encourage waste minimization, whether through voluntary means or through future regulatory action, must be based on a full understanding of the present state of hazardous waste generation and management and of how that system is evolving under the many pressures to which it is now being subjected. The general patterns and trends of hazardous waste management systems are becoming clearer, but past trends may not persist through the next four to six years as HSWA's new provisions take effect, and as industry seeks to control the potential financial liabilities associated with hazardous waste management.

Baseline and trends data: The best data available to the Agency on the amount and content of hazardous wastes were developed by surveys conducted in 1981 and 1983. These data are rapidly becoming out of date and are known to be of uneven quality because of reporting errors and the small and variable sample sizes from which information was extrapolated. They must be supplemented with new data documenting the changes that have already begun and will continue to progress over the next few years.

In order to make a final determination on the desirability and feasibility of mandatory waste minimization actions, the Agency must be able to document unresolved environmental problems for which such a new regulatory program would be the appropriate response. Examples might be waste streams for which treatment and disposal capacity remains inadequate even after the land disposal restrictions have been in place for a year or more, or a future EPA determination that a particular type of hazardous waste treatment method does not, in practice, adequately protect human health and the environment.

The types of data needed include detailed baseline information on the volumes and toxicity of wastes generated, trends data on source reduction and recycling, trends data on treatment and disposal capacity, and analyses of the human health and environmental impacts of treatment and disposal practices. EPA expects that existing statutory authority is sufficient to gather this additional data. One potential source will the biennial reports, which will be upgraded to improve the consistency and coverage of the information submitted. Other sources may include a new generator survey or the 1986 TSD survey currently being undertaken, information developed by EPA programs outside of the Office of Solid Waste (such as under TSCA), and the reporting requirements that may be enacted under amendments to CERCLA.

Data to support technical assistance and information transfer: Much of the same data can be used to set priorities for technical assistance programs to promote source reduction and recycling programs, targeting them where they will be most successful in reducing threats to human health and the environment. However, in-house research and cooperation with States and industry trade associations will provide more detailed information on the cost and effectiveness of specific waste minimization techniques for the targeted industries. This information gathering program will enable EPA to develop an accurate profile of waste management trends and practices and selectively develop performance standards or other requirements as needed.

A Core Waste Minimization Program

As this report has already emphasized, it is neither desirable nor practical to research, promulgate, and enforce a major regulatory program mandating specific waste minimization standards over the next four to six years. During this time, industry will be making technical and financial commitments to respond to the changing requirements and incentives of the hazardous waste management system. Once made, these commitments will be difficult to change. It is therefore both practical and highly desirable to conduct outreach programs to support and enhance the use of waste minimization as part of an overall waste management strategy and to reduce threats to human health and the environment. It should be noted that, in the event that mandatory controls are needed in the near term to control volume or toxicity of wastes generated by particular industries, EPA would use the authority that currently exists under Section 6 of the Toxic Substances Control Act.

Elements of this initial waste minimization program will include:

- Development and publication of an Agency policy statement on waste minimization including non-binding guidance to generators defining what constitutes waste minimization under the reporting and certification requirements of HSWA. To the extent possible, this guidance will be specific to particular industrial sectors and processes.

- Expansion of EPA's role in providing for technical and information assistance to generators, including small generators. Because the States have more direct contact with the generators and hence have more awareness of generators' needs and problems, EPA's primary role should be to support and encourage the States in the development of their programs. An appropriate EPA-sponsored technical assistance effort includes the following elements:

    - Assistance for States to initiate and develop programs for providing direct assistance to generators, especially small and medium sized generators.

    - Technical support of research and development and economic feasibility studies that might serve an entire region or have regional application.

    - Development of a computerized information system on waste minimization, accessible by the States.

- Encouraging voluntary waste minimization concepts within the review of new chemicals mandated under TSCA Section 5. EPA anticipates the preparation of a New Chemicals Information Bulletin advising submitters that waste minimization will be considered during the review of the relative risks of the new chemical substances and their existing substitutes.

The Agency should also establish a formal process of coordination with the States to ensure a continuing and responsive technical assistance and outreach effort over the longer term.

In addition, EPA will continue to examine specific elements of the "core" waste minimization program and make recommendations for legislative changes to the existing waste minimization requirements, if needed, as part of the next RCRA reauthorization. Among the possible options to consider would be modifications to the existing certification for generators and TSDFs, including:

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- Prohibiting, where appropriate, certification of certain types of waste management practices as waste minimization.
- Providing, where appropriate, formal guidance as to what may be certified as waste minimization. Such guidance could apply generally or to specific industrial sectors. (Flexibility for appeals and exceptions must also be provided.)
- Requiring generators who have not undertaken any of the approved waste minimization activities, but who certify that there is no economically practicable alternative to their present waste reduction and management practices, to provide a written explanation of such certification.

Longer Term Options

Only after the land disposal restrictions and other principal provisions of the HSWA go into effect, and after EPA has developed the needed additional data on hazardous waste generation and management, will it be possible to determine whether standards of performance (including phasedown permits) or required management practices (such as waste audits) are necessary to achieve additional reductions in the volume or toxicity of wastes. The Agency therefore recommends that consideration of new mandatory programs be deferred until after such data can be gathered and analyzed, and proposes to report back to Congress on the desirability and feasibility of prescriptive approaches two years after the first of the land disposal restrictions has been fully implemented. Excluding the possibility of case-by-case extensions, the first of the land disposal restrictions will be fully implemented in November of 1988; EPA will, therefore, make its next formal report on this subject in December of 1990.

Conclusion

EPA still has much to learn about waste minimization and recognizes that the cooperation of private and public waste generators will be invaluable as it moves toward the development of sound long term policy. It also believes, however, that the incentives and trends within the hazardous waste management system are unmistakable, and that the program presented here comprises the most positive and constructive steps that can be taken at this time. Aggressive action in favor of waste minimization is clearly needed, but a

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major new regulatory program—at least for the present—does not seem desirable or feasible.

Incentives for waste minimization are already strong, so EPA must capitalize on them. Most lacking is access by generators to the information that will demonstrate the economic benefits of waste minimization to industry, overcome logistical problems, and help develop creative new approaches. This can be provided by a strong technical assistance and information transfer effort, which can achieve through voluntary means what would be inefficient and possibly counterproductive to attempt through regulation. Unfortunately, non-regulatory programs have often failed at EPA for lack of statutory or regulatory deadlines and institutional advocacy. For such a program to work, it must be given strong organizational support within the Agency.

EPA is willing to make this commitment, and seeks support from Congress to ensure its success.

FACT SHEET

Waste Minimization Findings and Activities

U.S. Environmental Protection Agency

October 1986

FY 85-86: Activities

Developed waste minimization technical support document (TSD) entitled *Waste Minimization - Issues and Options*, which includes:

- Definition of terms
- National profiles of recycling and source reduction practices

Source Reduction Profile in TSD

- The following 22 production and manufacturing processes were studied for the source reduction component of the TSD:

Production processes included:

— Acrylonitrile
— Electroplating
— Inorganic pigments
— Organic dyes
— Petroleum refining
— Printed circuit boards
— Synthetic rubber
— 1,1,1-trichloroethane
— Vinyl chloride
— Agricultural chemicals
— Epichlorohydrin
— Metal surface treatment
— Paint manufacture
— Phenolic resins
— Printing operations
— Synthetic fibers
— Perchloroethylene
— Wood preserving

Manufacturing processes included:

— Good housekeeping
— Paint application
— Metal parts cleaning
— Process equipment cleaning

- These processes were selected from among 200 different industrial processes. Criteria for selection included:

  — Large volumes of hazardous waste generated
  — Toxic hazardous waste generated
  — Waste generated is part of California list of hazardous waste

- In the past, industry typically considered the implementation of source reduction practices only if such practices resulted in improved product yield or lower manufacturing costs.

- Since about 1970, however, environmental regulations under RCRA, the Clean Air Act, and the Clean Water Act have also, to some extent, influenced the use of source reduction techniques. In some cases, source reduction has occurred as a direct consequence of regulation, such as under the Clean Water Act requirements regarding wastewater treatment.

- Based on the qualitative analysis of the 22 production and manufacturing industries, extrapolated to all hazardous waste generators, it appears that the level of waste generation in terms of unit of waste per unit of product has declined over the last 15 years. Preliminary estimates suggest that industry might be generating about twice the amount of waste per unit of production than it does at present if no source reduction techniques were in place today.

- The potential for future reduction of waste appears to be significant. Preliminary evidence suggests that, within the next 25 years, aggregate waste generation volumes can be reduced an additional 15 to 30 percent by the extension of existing source control techniques.

- Through further extension of good housekeeping practices, waste minimization appears most promising in the industries characterized by high labor utilization, or where batch processing is used. Good housekeeping will have only limited effect in large-scale continuous processes with a relatively high degree of automation.

- For continuous processes generating large volumes of waste, the most promising SR technique is technology modification. Input material alteration is most effective in those processes where impurities constitute a high fraction of input materials.

- In a chemical process, catalyst use and reactor design appear to have the strongest potential impact on waste generation. Improved catalyst selectivity, along with optimum reactor design directly affects the amount of waste produced.

Recycling Profile in TSD

- Of the 42,000 M gal. of hazardous waste generated by U.S. industries in 1981, 1,575 M gal. (4 percent) were recycled.

Waste Group	Percent Recycled by Volumes
Solvents (halogenated and nonhalogenated)	24.0
Metal-bearing	28.0
Corrosives	29.0
Cyanides and other reactives	20.0
Halogenated organics (nonsolvent)	< 0.1

- Three manufacturing industries, the *Transportation Equipment* industry (SIC 37), the *Chemicals and Allied Products* industry (SIC 28), and the *Primary Metals* industry (SIC 33) accounted for 89 percent of the total volume of hazardous waste recycled in 1981. In contrast, generators in the *Motor Freight Transportation* (trucking) *and Warehousing* industry (SIC 42) did not report any recycling.

- Of the waste recycled, 81 percent by volume was recycled on-site.

- The breakdown of volumes of hazardous waste recycled according to onsite and offsite recycling suggests that the volume of waste recycled onsite increases as the total volume of waste recycled increases (i.e., facilities that recycle larger volumes of waste are more likely to recycle onsite).

- Offsite recycling accounted for the disposition of approximately 65 percent of the hazardous waste generated by SQGs in 1984. (Another 6 percent was recycled onsite.)

- Hazardous waste recycled in the greatest volume are dilute waste streams whose constituents can be reused in large-scale operations. This is true for the three highest volume waste streams recycled in 1981.

    - — Spent acids and alkaline solutions (D002) recycled in large volumes by the *Chemical and Allied Products* industry and the *Machinery-Except Electrical* industry.

    - — Wastewater treatment sludges from electroplating (F006) and chromium plating solutions (D007) recycled by the *Transportation Equipment* industry.

    - — Pickle liquor (K062) a corrosive, metal-bearing waste, recycled mainly by the *Primary Metals* industry.

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  - These four waste streams account for 49 percent of total volume of waste recycled in 1981.

- Suitability for recycling is dependent upon market demand for and purity of the material.

- Data indicate that the higher the weighted average concentration of known constituents in a waste stream the more probable the use of recycling as a waste management option.

Other FY 85-86 Activities

Regulatory

- Implementation of HSWA waste minimization requirements on manifest, condition for onsite permits, and biennial reports.

- Providing informal guidance to generators on waste minimization

  - Solvent recycling
  - Offsite recycling (in general)
  - Participation in a waste exchange

Technical and Financial Assistance

- $4.75 million were available in supplemental grant funding to EPA Regional Offices; waste minimization activities were eligible for funding. Several waste exchanges have received funding.

- EPA's Office of Research and Development (ORD) Small Business/SQG Research Program has partially funded waste minimization programs in Minnesota and North Carolina.

- ORD also administered funding to Tufts University for study on foreign practices in waste minimization (Japan, Canada, Western Europe).

- ORD's Hazardous Waste Environmental Research Laboratory (HWERL) conducted research on waste minimization techniques in printed circuit board industry.

- HWERL is also developing a waste audit procedure and conducting audits at eight hazardous waste facilities. Facilities were chosen based on previously identified waste groups, e.g., solvents, corrosives.

Information Sharing and Management

- EPA co-sponsored the 1985 conference, *Waste Reduction - The Untold Story* , in Woods Hole, Massachusetts.
- EPA co-sponsored the 1986 conference, *Waste Reduction - The Continuing Saga* , in Woods Hole, Massachusetts.
- EPA co-sponsored in June 1986, *The Third National Roundtable of State Waste Reduction Programs.*
- In November, EPA will be hosting another meeting of the *State Waste Reduction Programs.*
- EPA staff have made waste minimization presentations at more than 15 national conferences.

FY 87 Activities

- Development of non-binding guidance on what practices constitute waste minimization.
- Development of new waste minimization biennial report data sheet for more consistent and accurate data collection.
- Development of technical transfer documents from information/data collected in the waste minimization TSD.
- Development of a computerized waste minimization information/data bank accessible by States and industry.
- Continued R&D on waste audits and development of technical transfer documents.
- Incorporation of Waste Minimization in TSCA Premanufacturing Notices.

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